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MESOZOIC FOSSILS FROM THE SNAKE RIVER, CENTRAL NEW GUINEA.

BY M. F. GLAESSNER, PH.D., D.SC.

(Plates XIV–XV, text-figures 1–7.)

INTRODUCTION.

In 1943 Dr. F. W. Whitehouse, then on active military service in the area of operations between Wau and Lae (New Guinea), discovered fossils in phyllitic strata outcropping along the Snake River approximately 20 miles north-north-west of Wau. These beds had been mapped by Fisher (1944) as part of the " Kaindi Series " which was described as a series of more or less altered unfossiliferous rocks and placed tentatively in the Palæozoic. Dr. Whitehouse was unable to undertake a detailed study of the fossils as most of the specimens collected by him failed to reach Australia. He informed a number of his colleagues of his discovery and early in 1946 pointed out the exact locality to the present writer. Later, in a letter to Dr. K. Washington Gray, Chief Geologist of the Australasian Petroleum Company, Dr. Whitehouse stated that he had identified one of the remaining specimens in his collection as *Inoceramus*.

Thus, Dr. Whitehouse, the first discoverer of fossils in this area, was also the first to recognise among them a Mesozoic genus.

In order to obtain confirmation of these important discoveries, Dr. K. Washington Gray arranged for Mr. G. A. V. Stanley, D.S.C., Senior Geologist of the Australasian Petroleum Company, to proceed to the Snake River in September, 1946, for the purpose of collecting fossils and making further geological observations. By permission, the following description of his observations is reproduced here :—

" During Mr. Stanley's visit he collected 53 specimen bags of rock, and 9 other large pieces.

" The rocks are all more or less schistose, varying from very dark, graphitic and slaty schists, to brown phyllites and greenish-grey or dark-bluish-grey sandy (even gritty) rocks in which the bedding is still clearly apparent. The fossils are more abundant in the latter types, and in road cuttings can be seen as lines of cavities parallel to the bedding planes. On hillsides the cavities left by the fossils are easily found if careful search is made in the outcrops, and it is certainly surprising that their presence has not been earlier detected. For his part, Mr. Stanley has always directed his attention to searching for fossils in the calcareous (limestone and marble) bands in the Kaindi Series, and has unconsciously neglected the more argillaceous and sandy types.

" Mr. Stanley found no limestones interbedded in the thickness of 1,500 feet of rocks, over which his collecting extended. Fisher's map shows limestone lenses at the head of the Snake River.

"Igneous rocks are present in the area. Grey granite intrudes the schists between Sunshine and the Watut-Snake junction (Fig. 1), and at Gurukor Village there is a large mass of grey granite, evidently also part of the Morobe batholith. Boulders of a coarsely crystalline basic plutonic rock were found in a creek-bed not far from Mumeng.

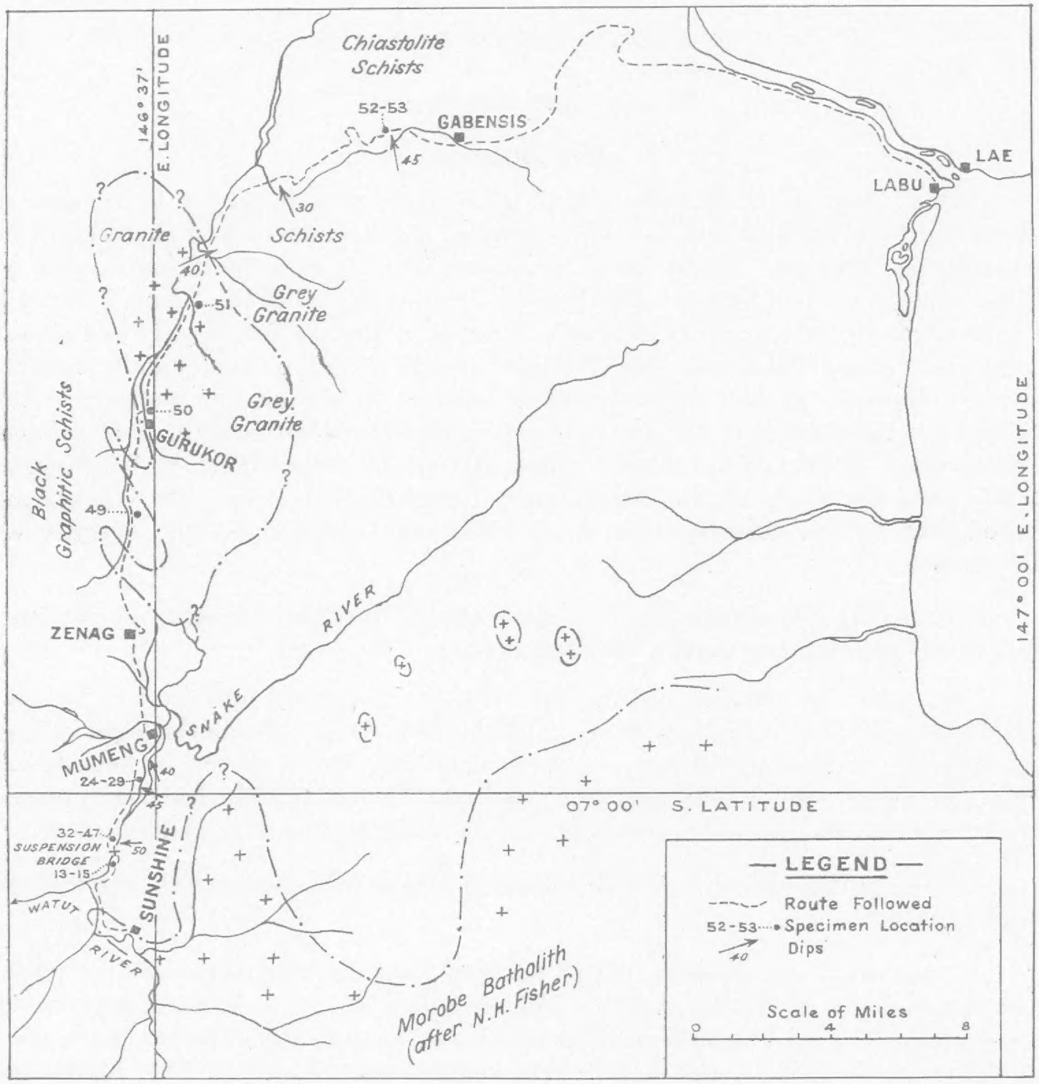

Fig. 1.—Locality map, by G. A. V. Stanley.

"Structurally, the beds from which the fossils are derived are comparatively simply arranged. They dip westwards at angles from 35° to vertical, and where massive sandy beds are present the bedding is well preserved. In the fine argillaceous facies foliation and contorting is apparent, especially close to granite contacts. The streams everywhere tend to conform to the strike of the beds. Faulting is common but does not seem to be of very great extent.

"No adequate description can be given here of the terraces of angular detrital material, hundreds of feet thick, which have filled the valley of the Snake River

between Zenag and the Watut Junction, and which are now well dissected by the present cycle of erosion. The deposits are typical of fanglomerates, but near Zenag the size and shape of the constituent blocks strongly suggests a tillite."

A specimen of the fossiliferous rock was submitted for petrological examination to Dr. A. B. Edwards, of the Mineragraphic Section, Council for Scientific and Industrial Research, Melbourne. He gave the following description of a thin section :—

"The shells occur in a fissile, hard, grey-black rock. It has a cleaved structure, and consists essentially of angular grains of quartz and more or less altered felspar, with minor amounts of biotite, muscovite, chlorite, tourmaline, zircon, apatite, leucoxene, and epidote, together with occasional rock fragments, in a matrix of sericite, fine-grained quartz and felspar, chlorite and carbonaceous matter. The rock has been extensively invaded by carbonate along the cleavage directions which are inclined to each other at about 30-40°.

"The quartz grains are about 0·2 mm. long or smaller. Some are equi-dimensional but many are elongated parallel to the general direction of cleavage, and some are fractured at right angles to their elongation as a result of stretching. Occasional stretched grains are bent, others are sharply separated at the fractures, which are filled with sericite or carbonate. Many of the grains have delicate projections, and their angularity may be due in part to shearing. They show little or no strain or granulation.

"The felspar about equals the quartz in abundance and is partly orthoclase, partly an acid plagioclase (oligoclase). It is cloudy from alteration to sericite, and some grains are completely altered to a lattice of sericite blades. The plagioclase appears less altered than the orthoclase. The grain size is similar to the quartz.

"These grains are cemented together by a matrix of sericite, fine-grained quartz and felspar, occasional films of chlorite, and carbonaceous matter. The other minerals present occur scattered throughout this matrix, the micas tending to lie parallel to the cleavage directions. The carbonaceous matter occurs as strings in the grain boundaries and emphasises the cleavage directions of the rock.

"The rock fragments consist of fine-grained chert-like material, quartzite, carbonaceous shale (?) and granite (?). One fragment of carbonaceous shale is horseshoe-shaped, as though rolled like the fossils. One fragment of (?) granite consists of interlocking grains of quartz, oligoclase and orthoclase, another consists of interlocking plagioclase and orthoclase.

"It is probable that the rock is not greatly different in general composition and characters from the Purari greywackes (Edwards 1947). It is clearly ill-sorted, the grains are angular, and the source material was largely granitic. The name "schist" is ill-chosen for such rocks. They would be better described as cleaved felspathic sandstones or greywackes. There has been no recrystallization of the constituents as would be expected in a schist."

OCCURRENCE AND PRESERVATION OF FOSSILS.

The fossils are not evenly spread through the rock but occur in local concentrations and fossiliferous layers. Some shells were unbroken and there are no signs of wear and abrasion, but many were embedded in the matrix as fragments. Most of the lamellibranchs are preserved as single valves, but one specimen of *Cucullaea* consisted of both valves, which were only slightly displaced before the sediment was lithified. The larger and heavier shells do not lie in the bedding planes. The occurrence of the fossils indicates rapid deposition in shallow water, which agrees with the ill-sorted composition of the sediment.

All molluscan shells were replaced by crystalline calcite, which is mostly closely welded to the surrounding sediment. This makes identification of the fossils difficult. Weathering, however, has dissolved the calcite, leaving remarkably clearcut casts and moulds.

The fossils are very much distorted. The general effect is apparently a strong compression at right angles to the bedding planes and intense stretching in one direction along the bedding planes. The resulting deformation is particularly striking in the case of large *Cucullaea* and *Trigonia* shells originally embedded in the rock at an angle to the bedding plane. The distortion of some of the figured specimens is explained in text-figure 2. As the known shape of the fossils makes it possible to

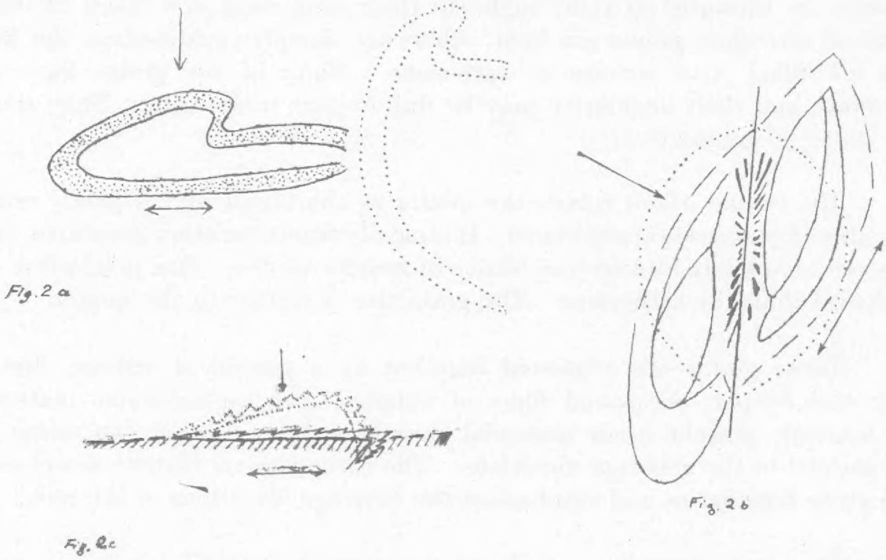

Fig. 2.—Examples of distortion of Snake River fossils—

a—*Cucullaea* (*Ashcroftia*) *distorta* sp. nov. Cross section of specimen pl. XIV. fig. 1 with superimposed reconstructed section showing little change in length and width.

b—Same species, cross section of specimen pl. XIV fig. 2 with superimposed reconstructed section.

c—*Trigonia* (*Acanthotrigonia*) *phyllitica* sp. nov. Cross section of specimen pl. XV fig. 1 and reconstructed section.

reconstruct the original shape of a fossiliferous rock specimen prior to its deformation, a detailed study of this deformation including the relation of rock texture, cleavage, &c., to local and regional direction of stress as revealed by the folding of the fossiliferous strata and by the structural behaviour of the intruding batholith would be particularly fruitful. For this purpose it would be necessary to take oriented specimens in the field. Such specimens are not at present available.

The most striking feature is the preservation of fine detail concurrently with intense distortion of the general outline and proportions of the shells. This is due to the replacement of the original shell material by crystalline calcite prior to the stress action. The calcite crystals yielded to the stress by slip movements along cleavage planes. They were not granulated and did not wedge or thin out in the same manner in which the sandy and argillaceous freely yielding matrix reacted. In the calcitic shells little alteration occurred in the configuration of most of the small segments of the valves (Pl. XIV, fig. 1b) which were compressed and stretched. Pl. XV, fig. 9, shows clearly the small " step-faults " in the calcite of a shell along transverse cleavage planes, preserved on the surface of a cast. The relation between the spacing of these planes and the size of the replaced structural elements of the shell is such that small structures such as hinge teeth were not obliterated but either yielded to stress as well as the coarser parts, or were even less affected. The step-like surfaces of the sheared calcitic shells cannot be freed mechanically from the matrix.

Although it is somewhat hazardous to describe as new species fossils preserved in a highly altered rock which makes it impossible to determine their exact proportions and to recognise all details of the ornamentation of their shells, the most common species belonging to recognisable genera are here named for further reference. Even if further fossiliferous localities are found in this area they can hardly be expected to yield perfectly preserved specimens of the fauna as the rocks are regionally metamorphosed.

DESCRIPTION OF THE FAUNA.

(*a*) LAMELLIBRANCHIA.

Genus *Cucullaea* Lamarck 1801.

The taxonomic position of the Mesozoic representatives of *Cucullaea* (*sensu lato*) has not been clearly established. Many authors make dictinctions of subgeneric rank between them and the typical Cainozoic *Cucullaea* (genotype *C. auriculifera* Lam. = *C. labiata* Solander). The oldest name for a pre-Tertiary *Cucullaea*-like genus is *Cyphoxis* Rafinesque 1819, but this name is rejected by Wade, Cox and other authors who point out that it was based on unidentifiable casts. This would make the later designation *Idonearca* Conrad 1862 available. The genotype is *I. tippana* Conrad (a synonym of *C. vulgaris* Morton, from the Upper Cretaceous). A new genus *Ashcroftia* was described more recently by Crickmay (1930), with *A. inversidentata* from the Middle Jurassic of British Columbia as the only species. It differs mainly in the arrangement of the hinge. The central pair of teeth forms an inverted V, with about 3 oblique teeth on either side, followed by 3–4 sloping, elongate, hooked teeth. Crickmay states that probably many of the Jurassic *Cucullaea* belong to *Ashcroftia* and without mentioning Lower Cretaceous species goes on to say that *Latiarca* Conrad and *Idonearca* Conrad are the Upper Cretaceous and early Cainozoic forebears of the later Cainozoic and Recent *Cucullaea* s. str. Arkell (1936) accepts *Ashcroftia* as a new " subdivision " of *Cucullaea*. Two other subgenera may be mentioned briefly for comparison. *Dicranodonta* Woods 1899 (subgenotype *C. donningtonensis* Keeping) from the Lower Greensand is distinguished by long ventrally curved lateral teeth which are nearly parallel and often bifurcating. There is a pronounced difference between them and the small median teeth, which are vertical

and become oblique laterally. The hinge structure of *Cucullona* Finlay and Marwick (subgenotype *C. inarata* Finlay and Marwick) from the Danian of New Zealand and the Lower Eocene of Victoria resembles that of *Dicranodonta.* In the two last-named subgenera the valves have crenulated margins.

Cucullaea (*Ashcroftia*) *distorta* sp. nov.

(Pl. XIV, fig. 1–4 ; text-figure 3.)

Material.—Internal casts and partial external moulds of six specimens.

Holotype : Melbourne University Geology Department No. 1949 (Pl. XIV, fig. 3).

Most casts are of single valves which are greatly distorted but show hinge and area structures clearly. The surface sculpture of the valves is mostly obscured or obliterated. One specimen consists of the internal cast of two distorted valves which are slightly separated, showing the cast of the hinge between them ; the umbonal portions are broken off (Pl. XIV, fig. 2). Another specimen shows the internal cast and external mould of a large single valve which is dorso-ventrally flattened ; the space once occupied by shell material is now filled with spheroidal bodies of matrix connected by narrower bridges. This is clearly the internal cast of the borings produced in the shell by a sponge related to *Cliona* (Pl. XIV, fig. 1a, b). Similarly shaped but phosphatic casts on a lamellibranch from the Senonian of Texas were described as *Cliona microtuberum* Stephenson (Univ. Texas Bull. 4101, p. 54, 1941).

Occurrence.—Frequent in fossiliferous greywacke, Kaindi Metamorphic Group, Snake River, 20 miles north of Wau, Morobe District, New Guinea.

Diagnosis.—A large *Cucullaea* with a wide area with 6–10 chevron-shaped ligament furrows ; 18–20 well-developed hinge teeth, diverging outward and downward from the median plane ; the median group grading into the two lateral groups each consisting of 4–5 long sloping partly hooked teeth. Valve margins smooth.

Description.—Large, thick-shelled, inflated valves. Surface sculpture not well preserved but probably radials well developed on right valve ; left valve apparently almost smooth. Valve margins not crenulated. Area flat and very wide, with six to ten chevron-shaped, slightly sinuous, widely and regularly spaced ligament furrows. Hinge consisting of 18 to 20 strongly developed and clear-cut teeth ; about half this number occupying the median part of the hinge margin, divergent from the median plane of the valve and sloping ventro-laterally ; they are followed without a sharp break by 4 or 5 lateral teeth which are longer and sloping at a lower angle in a ventro-lateral direction ; some of the lateral teeth are hooked, particularly in the anterior portion of the hinge. It is possible that a weak raised ridge was developed on the median side of one of the adductor scars, but distortion makes this observation uncertain. The existence of an umbonal ridge is similarly uncertain. Length of hinge estimated at 40–50 mm., greatest height of valve probably about 50–60 mm.

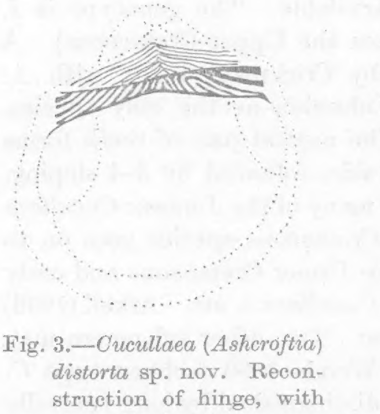

Fig. 3.—*Cucullaea* (*Ashcroftia*) *distorta* sp. nov. Reconstruction of hinge, with generalised outline.

Comparison.—This species differs from *C.* (*Ashcroftia*) *inversidentata* mainly in the greater number of hinge teeth. It is distinguished from *C.* (*Dicranodonta*) *donningtonensis* and from the species of the subgenus *Cucullona* Finlay and Marwick by the lack of crenation of the valve margin and by the strongly developed median teeth which grade into the lateral series. This serves to separate the new species from the typical *Idonearca*, *Latiarca*, and *Cucullona* while the ventro-lateral slope of the teeth is different from that in the typical *Cucullaea*. A comparison of Crickmay's figure of *Ashcroftia inversidentata* (1930, pl. 2, fig. d) with Wade's figure of *Cucullaea* (*Idonearca*) *vulgaris* (1926, pl. 9, fig. 3) shows that the differences between these subgenera are not fundamental as the Upper Cretaceous species also possesses sloping hooked lateral teeth developing more or less gradually out of the median series. The median teeth are less regular, more numerous, and smaller. The hinge of the new form resembles that of the Jurassic species more closely but its larger number of teeth places it morphologically in a somewhat intermediate position between *Ashcroftia* and the typical *Idonearca*.

Genus *Glycymeris* da Costa 1778.

Glycymeris sp.

(Pl. XIV, figs. 5, 6 ; text-figure 4.)

Material.—10–12 internal casts, mostly showing the hinge structure well preserved. Sample localities include 45 (*see* map, fig. 1), and 12 (1 mile south of 45).

Occurrence.—Frequent in fossiliferous greywacke, Kaindi Metamorphic Group, Snake River, 20 miles north of Wau, Morobe District, New Guinea.

Description.—Shell rounded, small, up to about 25 mm. in diameter ; valves subcircular, apparently gently vaulted. Dorsal margin straight, ventral margin rounded, internally crenulated, with approximately 35 crenulations visible in one of the valves (P.l XIV, fig. 5) Ligamental area not clearly preserved, probably small. Hinge plate wide and high. 8–10 small vertical median teeth are followed laterally without a break by 5–6 larger chevron-shaped radial to transverse lateral teeth which are somewhat larger but not elongated. The raised areas bordering the adductor scars are faintly visible in the distorted casts. The external surface is not well preserved, but indications of faint radial ribs are visible in an external mould of the lateral portions of a valve.

Fig. 4.—*Glycymeris* sp. Reconstruction.

Remarks.—The casts of the hinge teeth are preserved in a manner which gives the fossil the general appearance of a nuculid, but when impressions are taken and examined the transverse position and chevron-like shape of the lateral teeth become clearly visible. As neither the outlines and curvature of the valves nor their surface sculpture are clearly visible specific identification of this fossil is impossible. It is comparatively common.

Genus *Trigonia* Bruguière, 1789.

The taxonomy of this important group of lamellibranchs was discussed in recent years by Crickmay (1932) and Rennie (1936). It seems advisable to recognise the divisions listed by Crickmay and at least some of those subsequently proposed by other authors, but to consider them as subgenera as suggested by Rennie.

Sculptured external moulds of *Trigonia* valves in the collection from the Snake River indicate that several species belonging to more than one of the subgenera are present, but only one species is represented by sufficient material to justify a description.

Trigonia (*Acanthotrigonia*) *phyllitica* sp. nov.

(Pl. XV, figs. 7, 8.)

Material.—Holotype : Cast and external mould of a right valve, compressed but with the outline and ornamentation of the area and the posterior portion of the shell comparatively well preserved. Melbourne University Geology Department, No. 1951.

Paratype A.—Smaller left valve preserved as a perfect cast of the umbonal and hinge region, with external mould of the anterior portion (sample 47). Melbourne University Geology Department, No. 1952.

Paratype B.—Immature specimen (sample 45). Also various casts and moulds of fragmentary specimens. Melbourne University Geology Department, No. 1953.

Occurrence.—Rare in fossiliferous greywacke, Kaindi Metamorphic Group, Snake River, 20 miles north of Wau, Morobe District, New Guinea.

Diagnosis.—A small *Trigonia* with sub-parallel diagonal ridges on the area, forming along the blunt marginal ridge acute angles with the oblique tuberculate sharp flank ribs.

Description.—Shell small, valves triangular, anterior margin convex, postero-dorsal margin slightly concave, posterior end rounded. Area and escutcheon wide, separated from the flank of the valve by a blunt ridge without a distinct keel. The costæ of the posterior portion of the flank (10 in the holotype) commence at this ridge which becomes indistinct towards the margin. Area wide, convex ; junction with escutcheon not preserved. Escutcheon (of an immature specimen, paratype B) apparently ornamented with ribs bearing strong beads. Area covered with fine but distinct sub-parallel ribs which are slightly concave toward the umbo and cross the area diagonally from the marginal carina inward and backward towards the postero-lateral valve margin. They become obsolescent near the lateral edge of the valve. The flanks are ornamented with about 20 oblique, sharp, almost straight costæ on which small protuberances are regularly arranged. A distinctive feature of the ornamentation is the acute angle (45–60°) between flank and area ribs where they meet on the marginal ridge. Inner valve margin crenulated. Casts of finely ribbed large hinge teeth are preserved in several specimens. Height of holotype valve about 30 mm., estimated length about 40 mm.

Remarks.—The present species is assigned to *Acanthotrigonia* van Hoepen not so much because of its relation to the subgenotype (*Trigonia shepstonei* Griesbach from the Upper Cretaceous of East Africa) as its clear connection with the " *spinosa*-group " of the " scabrae." This group was first distinguished by Lycett (1875, p. 115), and Crickmay (1932) concluded his description of *Acanthotrigonia* with the following statement : " This genus is the group of the spinose scabrae and is quite distinct from other groups of scabrae." Of the distinguishing features listed by Crickmay after van Hoepen (1929) the following can be seen in the present specimens : The " moon-shaped trigonoid " outline, moderately incurved opistogyral umbo, tuberculate costae which are sharply triangular in cross section and which approach the area at an acute angle, transverse costellae of the area, obsolete carina and crenulate interior valve margin. This subgenus is restricted to the Cretaceous.

Genus *Cardium* Linnaeus, 1758.

Cardium sp.

(Pl. XV, figs. 9, 10.)

Five large internal casts of a large cardiid shell include specimens from sample localities 39, 40 and 43. They are all higher than long, the largest reaching a height of 80 mm. and a length of 50 mm. The hinge teeth are strong, the laterals and one strong triangular cardinal tooth being preserved in most of the casts ; the interior valve margin is finely crenulated. The surface ornament is not known.

Genus *Volsella* Scopoli.

Volsella sp.

(Text-figure 5.)

A single specimen from sample locality 26 is assigned to this genus. It is represented by the anterior half of a slightly distorted internal cast, 85 mm. long and 75 mm. high. The distortion which is illustrated in fig. 5b has depressed the

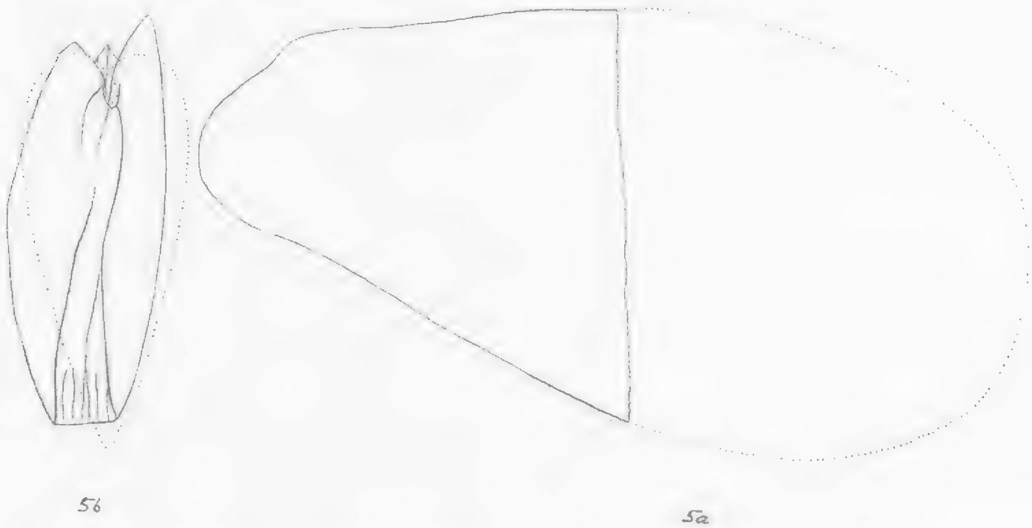

Fig. 5.—*Volsella* sp. a—reconstruction of outline, b—diagrammatic anterior view with reconstruction.

umbones below the dorsal margin giving the shell a somewhat *Pteria*-like general appearance, but closer inspection shows them to be well removed from the anterior end of the valve and just below the position to which they have been restored in the accompanying outline drawing.

Genus *Inoceramus* Parkinson.

Inoceramus sp.

The occurrence of this genus in the fossiliferous beds on the Snake River was established by Whitehouse (personal communication). External moulds of fragmentary shells with strong concentric sculpture which were found at sample locality 37 are also assigned to *Inoceramus*.

LAMELLIBRANCHIA indet.

A number of casts of heterodont inequilateral flat valves of *Tellina*-like general appearance have been observed but are too poorly preserved for identification. They occur at sample localities 13 and 15.

(b) GASTROPODA.

Genus *Tibia* " Bolten " Roeding, 1798 (*Rostellaria* auct.)

A gastropod with its outer lip extended to form a well-developed wing ending in lobate and scythe-shaped digitations seemed to resemble certain Cretaceous Aporrhaidæ of a group including the genus *Anchura* Conrad. However, when the outline was reconstructed from several slightly distorted individuals and the drawing sent to Dr. L. R. Cox, with a request for an opinion on the generic position of this fossil, Dr. Cox replied that it was unlike *Anchura* and difficult to place but that it could perhaps be included in *Tibia* (= *Rostellaria* auct.) *sensu latissimo*. The diagnostic features involved can be best explained by quoting A. Morley Davies (1935, pp. 262–3): " The safest distinction between the two families (*i.e.* Aporrhaidæ and Strombidæ) appears to be the relation of growth-line to suture. . . . A less satisfactory distinction is the absence of a true anterior notch in Aporrhaidæ, that family being rather rostrate holostome than truly siphonostome." The growth-lines cannot be seen distinctly in the present fossils, but the anterior notch is clearly visible in at least two specimens.

Tibia (?) *morobica* sp. nov.

(Pl. XV, fig. 11, 12 ; text-figure 6.)

Material.—Internal casts and external moulds of at least four specimens, two of them showing the labrum with well-preserved outline but somewhat extended by distortion, and traces of surface sculpture.

Holotype.—Melbourne University Geology Department No. 1950. (Pl. XV, fig. 11.)

Occurrence.—Frequent in fossiliferous greywacke, Kaindi Metamorphic Group. Snake River, 20 miles north of Wau, Morobe District, New Guinea.

Diagnosis.—Shell elongate, labrum consisting of an anterior lobe and a hooked main wing ending in a scythe-shaped posterior projection. Weak longitudinal ridges on the earlier whorls.

Description.—Shell with about 5 whorls, apparently short and wide, with smooth and gently convex outline ; sutures distinct, depressed. Outer lip forming a broad wing with a distinct posterior scythe-shaped projection (not preserved in the holotype). It is separated by a deep rounded sinus from a shorter rounded anterior digital extension ; a distinct anterior notch is developed between it and the short anterior canal which reaches about $\frac{1}{4}$ of the length of the last whorl. The labrum extends nearly to the upper edge of the preceding whorl. A strong internal marginal thickening is found on the outer edge of the main projection of the labrum which generally does not appear to have been thick or callous. The surface ornamentation was apparently weak, consisting of blunt longitudinal ridges which disappear on the last whorl. There are only faint traces of spiral ornamentation.

Fig. 6. *Tibia? morobica* sp. nov. Reconstruction.

Measurements.—Holotype : About 18 mm. long, 6 mm. wide, length of labrum between anterior and posterior notches 6 mm., distance of wing tip 7 mm. Paratype A : About 23 mm. long, 10 mm. wide (crushed), anterior canal about 7 mm. long, distance between wing tips 15 mm. Paratype B : Length from apex to base of anterior canal about 25 mm., greatest width 28 mm. (crushed). The outline of the labrum does not seem to be greatly affected by distortion of the specimens but reconstruction of the proportions of the spire is difficult and actual measurements are uncertain.

GASTROPODA indet.

Several external moulds indicate the occurrence of other types of gastropods which are not sufficiently well preserved for identification. (Sample localities 28, 37.) They include a low-spired trochoid shell and an external mould of a fairly large form possibly representing the Volutidæ.

THE AGE OF THE SNAKE RIVER FAUNA.

The following fossils have been identified from the Snake River greywacke which forms part of the Kaindi Metamorphic Group in the Morobe District of Central New Guinea :—

SPONGIÆ.
- *Cliona* sp. (borings in shells of *Cucullaea*).

LAMELLIBRANCHIA.
- *Cucullaea* (Ashcroftia) *distorta* sp. nov.
- *Glycymeris* sp.
- *Trigonia* (*Acanthotrigonia*) *phyllitica* sp. nov.
- *Cardium* sp.
- *Volsella* sp.
- *Inoceramus* sp.

GASTROPODA.
- *Tibia ? morobica* sp. nov.

This is clearly a Mesozoic fauna. As no known species could be recognised in it, its age can be fixed only by means of an examination of the stratigraphic ranges of the genera represented. *Cucullaea* is known from Jurassic to Recent. The subgenus *Ashcroftia* to which the species from the Snake River has been assigned is known only in a single species from the Jurassic. The taxonomy of the Mesozoic representatives of *Cucullaea* has not been studied in sufficient detail to exclude the possibility that other species, possibly of different age, could also belong to that subgenus. Besides, the new species is intermediate in its hinge structure between *Ashcroftia* and the Upper Cretaceous type species of *Idonearca*. The conclusion that the new species of *Ashcroftia* must also be Jurassic would therefore be unjustified. A Cretaceous age of the fauna is clearly indicated by the occurrence of a *Trigonia* of the subgenus *Acanthotrigonia* which is restricted to the Cretaceous (Crickmay 1930) and has a wide geographic range. This is supported by the discovery of *Glycymeris* which is not known from pre-Cretaceous strata. The ranges of the other genera recorded from the Snake River fauna are in agreement with Cretaceous age which is therefore accepted.

At the present state of our knowledge it is difficult to arrive at a more definite conclusion. None of the fossils recorded makes it possible to place the fossiliferous strata definitely in any particular part of the Cretaceous System. There are however certain considerations favouring a position within the interval from Aptian to Albian or Cenomanian. There is a definite resemblance in lithology and facies with the Purari Formation (Carey 1945, Glaessner 1945). This formation which has been placed in the Aptian-Albian contains a fauna dominated by lamellibranchs (including *Trigonia* but not *Cucullaea*) and the gastropod *Anchura* which occur in " lumachelle"-like concentrations in a sequence of unmetamorphosed strata mostly composed of shales and greywacke (Edwards 1947). The group of *Trigonia* represented in the Snake River fauna seems to be more characteristic of the later than the earlier part of the Cretaceous. Finally, Late Cretaceous faunas are very well known throughout the Pacific Region and none of their distinctive elements has been found in the fauna here described. These are admittedly only weak indications but they justify the expectation that this Cretaceous fauna will eventually be found to be younger than Neocomian and older than Senonian.

THE SIGNIFICANCE OF THE SNAKE RIVER FAUNA.

The discovery of this fauna by Whitehouse, the collections and observations made by G. A. V. Stanley and the determination of its age as Cretaceous have a far-reaching importance for the geology of New Guinea. The significance of these discoveries is three-fold. Firstly, they indicate that the intrusion of the Morobe batholith which according to N. H. Fisher and G. A. V. Stanley affected the Snake River beds occurred not earlier than the Cretaceous. Secondly, they suggest localization of the metamorphism affecting the Kaindi Group (contact and dynamo-metamorphism), as sediments of the same age are known to be entirely unmetamorphosed over a large area of the Central Highlands west of the Miocene Aure Trough. Thirdly, they make it likely that metamorphic strata resembling the Kaindi Group which have been described from other parts of the New Guinea area may also prove to be Cretaceous. The distribution of metamorphosed and unmetamorphosed Cretaceous indicates that structural trends in this area are less simple than had been assumed (fig. 7).

(*a*) The Age of the Morobe Batholith.

The Morobe batholith was mapped, described, and named by Fisher (1944). It is about 50 miles long and 25 miles wide, extending north-east and south-west of the Wau-Bulolo goldfields area, which occupies a saddle-shaped transverse depression in its central part. The principal intrusive rock is described as " a slightly acidic granodiorite, or adamellite," which " has been the direct source of a considerable proportion of the gold mineralisation." The age of the Kaindi metamorphics which it intrudes could not be directly determined prior to the discovery of the Snake River fossils. The only evidence for the age of the intrusion available to Fisher was the observation that in places along its western margin the granodioritic mass was overlain by volcanics followed by Tertiary sediments containing boulders of the " granite." The age of the Tertiary marine sediments in this area (Langimar valley) was determined by the Commonwealth Palæontologist (Miss Irene Crespin) in unpublished reports as Middle Miocene and the basalts intervening between the

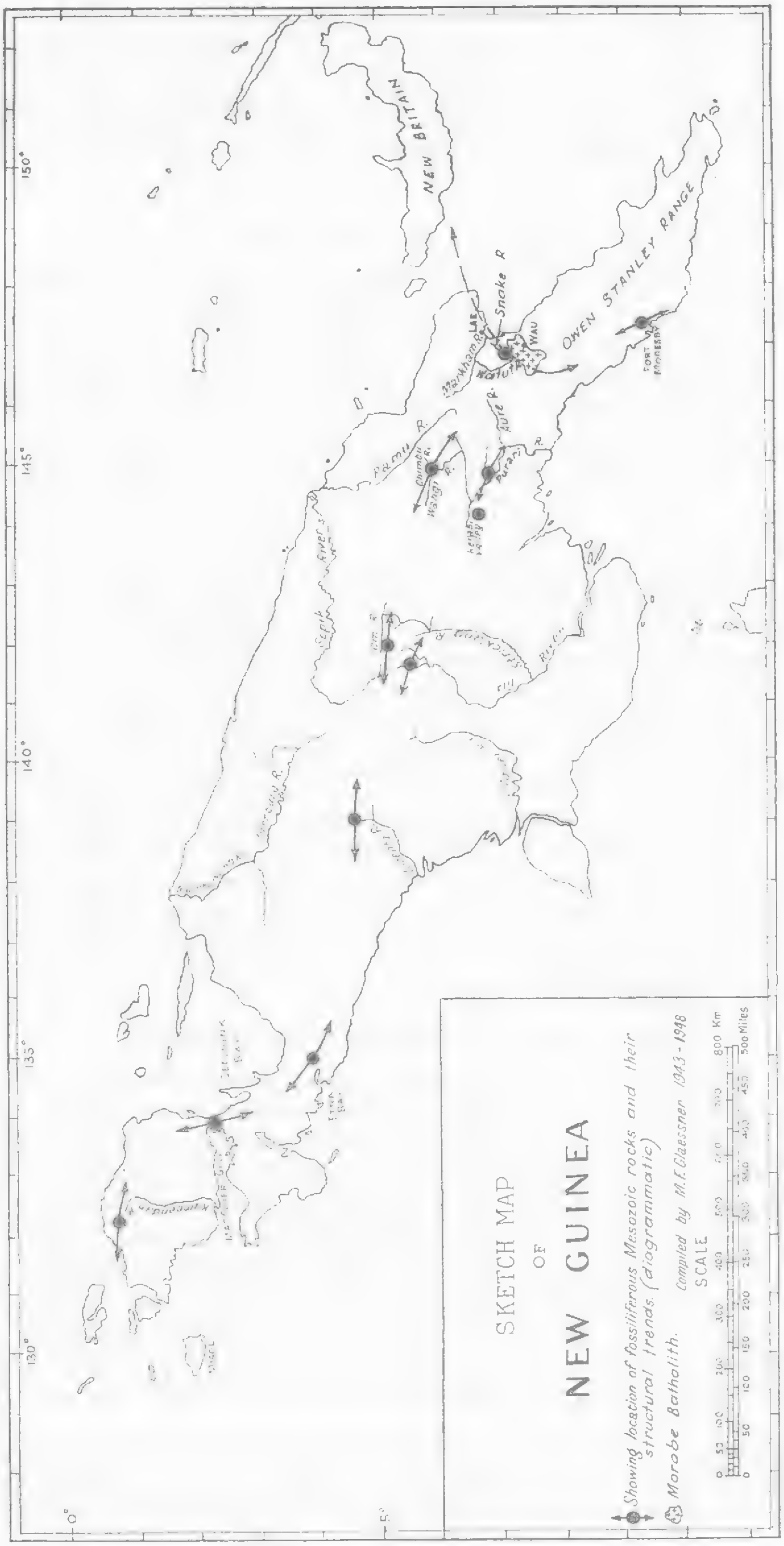
SKETCH MAP
OF
NEW GUINEA
Showing location of fossiliferous Mesozoic rocks and their structural trends. (diagrammatic)
Morobe Batholith.
Compiled by M.F. Glaessner 1943-1948
SCALE
800 Km
500 Miles
NEW BRITAIN
OWEN STANLEY RANGE
Snake R.
LAE
WAU
PORT MORESBY
Ramu R.
Aure R.
150°
145°
140°
135°
130°

Fig. 7.

"granite" and the marine beds are probably Lower Miocene or Upper Oligocene. This left a very wide margin for the age of the intrusion and Fisher's conclusion was that it was possibly as early as late Palæozoic but probably Mesozoic. Having placed the Snake River beds in the middle part of the Cretaceous we are forced to the conclusion that the batholithic intrusion took place in Late Cretaceous or Early Tertiary time.

(b) Metamorphosed and Unaltered Mesozoic Rocks.

It has been stated that in Netherlands New Guinea some Mesozoic rocks, believed to be mainly Jurassic, had been altered to phyllites ("glansleien"), but available data are insufficient for a discussion of the circumstances and areal distribution of this alteration. In a large portion of the Central Highlands of the Australian part of New Guinea a thick sequence of Jurassic and Cretaceous rocks is known to be developed as an unaltered gently folded series of rocks (Osborne 1945, Carey 1945, Glaessner 1945). Evidence of the occurrence of granites of higher age than that now established for the Morobe Batholith is found in the occurrence of granitic pebbles in the Jurassic of the Fly River and in a component of granitic origin in the Purari greywacke of Aptian-Albian age (Edwards 1947). Large granite masses appear underneath the Jurassic at the base of the thick unaltered sedimentary series of the Wahgi valley and were originally considered as part of the basement, but alternative interpretations of the field evidence have been suggested. In any case the fact remains that a thick series of unaltered sediments ranging from Upper Jurassic to Cenomanian (with interruptions) is developed in the Central Highlands from the International boundary to the Tertiary zone extending across the island from the Lower Purari River to the Lower Markham (Aure Trough, Beltz 1944). East of this Tertiary trough is the type area of Fisher's Kaindi metamorphics which at least in part can now be correlated with a portion of the Wahgi and Purari sedimentary series. No unaltered rocks older than uppermost Senonian have so far been described from the eastern part of New Guinea. These relations suggest an important difference in the Late Cretaceous and Tertiary history between the areas east and west of the Aure Trough.

(c) The Trend of the Kaindi Metamorphics.

Fisher (1944) described the structure of the Kaindi Group as "a series of broad folds trending in a generally northeast-southwest direction." Eastwest to southeast-northwest strikes were observed in the central goldfields area of Wau-Bulolo, which is situated in a transverse saddle across the main north-east-south-west axis of elongation of the batholith. A statistical analysis of strikes measured in the Kaindi metamorphics, mainly by Fisher and Noakes, and including those measured recently by G. A. V. Stanley in the Snake River area, confirms Fisher's statement and shows clearly that the folding in this area, with which the elongation of the batholith conforms in the usual manner of such intrusions, is not parallel to the main axis of the island of New Guinea. It is parallel to the axis of the Tertiary Aure Trough which seems to have developed as a foredeep in front of this folded zone.

The Morobe area with its metamorphic Mesozoic strata is part of an arcuate folded structure of Late Mesozoic and Early Tertiary age. It develops out of the north-westward trend of the Owen Stanley Range in Papua at about lat. 147°, thence

swinging northward, north-eastward and eastward towards the Huon Gulf between Lae and Salamaua. Its prolongation may form the basement of the Tertiary rocks of the Rawlinson Range between Lae and Finschhafen, and emerge again as the metamorphic and plutonic basement of the Whiteman and Nakanai Ranges of New Britain, described by Noakes (1942) as a series of schists and phyllites resembling the Kaindi metamorphics and likewise intruded by a granodiorite.

It was stated in an earlier publication on Mesozoic fossils from New Guinea (Glaessner 1945, p. 162): "The known pre-Tertiary basement in a wide zone including the northern coastal ranges of New Guinea, the Bismarck Archipelago, the Solomon Islands, New Hebrides, Fiji and Tonga consists entirely of metamorphic or plutonic rocks." As far as pre-Upper Senonian rocks are concerned, this statement could also apply to the Morobe Arc and its continuation in the Owen Stanley Ranges (where both metamorphosed and unmetamorphosed *Globotruncana*-rocks of Upper Senonian age occur in the Port Moresby area). It should be qualified by the remark that the metamorphics may include locally less altered fossiliferous beds; that Cretaceous fossils occur in them in the Morobe area; and that similar fossils can be expected to occur locally under favourable circumstances elsewhere in the area outlined above, particularly in New Britain.

ACKNOWLEDGEMENTS.

The writer is indebted to Mr. G. A. V. Stanley, D.S.C., for the valuable collection here described and for permission to quote from his report; to Dr. F. W. Whitehouse for his kindness in making detailed information on the fossil locality and his observations available; to Dr. L. R. Cox, British Museum (Natural History), for valuable taxonomic and bibliographic information; to Dr. A. B. Edwards for a petrographic examination of the fossiliferous rock; to Dr. N. H. Fisher for discussion of geological problems; to Professor E. S. Hills, who kindly made facilities at the Geology Department of Melbourne University available for this work; and to the Directors and the Chief Geologist of the Australasian Petroleum Company (Dr. K. Washington Gray) for permission to publish this paper.

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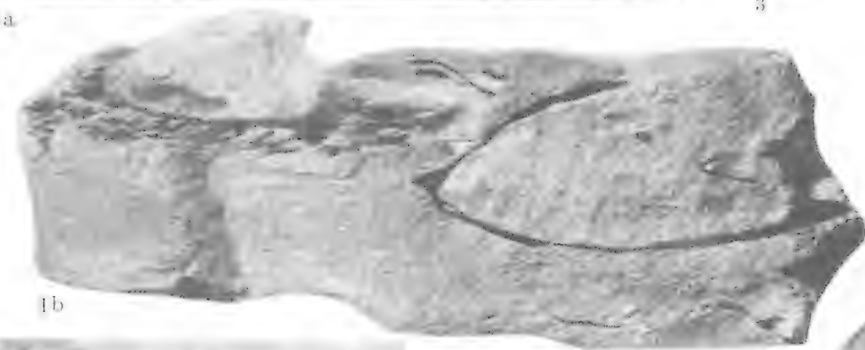
PLATE XIV.

1a

3



1b

2

5

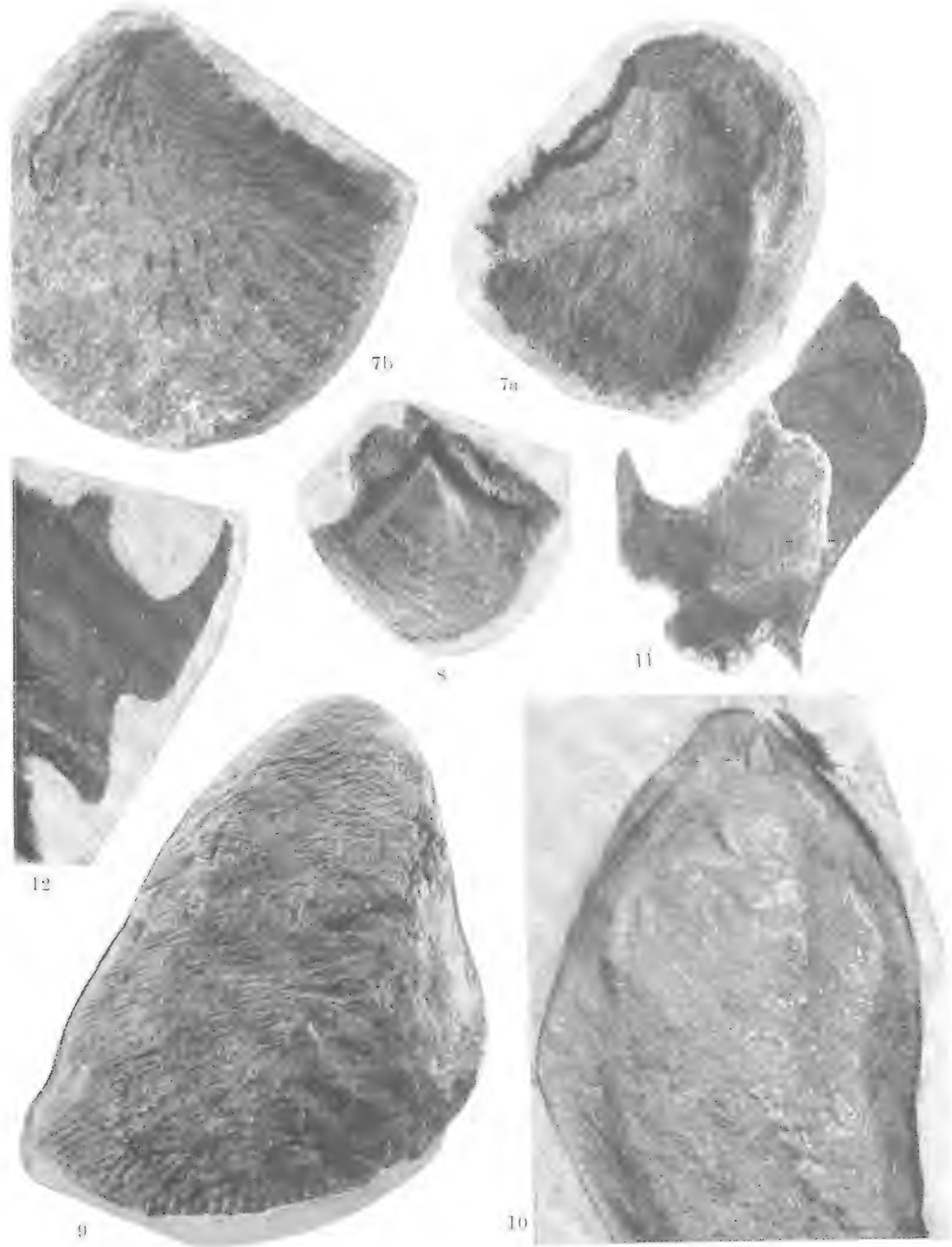
4a

6a

4b

6b

PLATE XV.



7b 7a 8 11 12 9 10

EXPLANATION OF PLATES.

PLATE XIV.

Figs. 1–4. *Cucullaea* (*Ashcroftia*) *distorta* sp. nov. Nat. size.

1a, b. Distorted internal cast showing broken umbonal region, hinge teeth, and portion of shell replaced by casts of *Cliona*-borings. a—dorsal view, b—lateral view, also showing sections of two similarly distorted unidentified lamellibranch valves (centre and right).

2. Cast of two valves in apposition ; umbones broken off ; casts of hinges in centre ; partial external mould showing radial sculpture at left.

3. Distorted external mould of dorsal portion of valve showing hinge (above), area with ligament grooves (centre), and umbonal part of valve (below).

4. Artificial (plastic) cast of specimen shown in fig. 3. a—dorsal view, b—view of hinge. Umbonal cavity and teeth not completely filled in casting, one of the teeth accidentally displaced. Note strong dorso-ventral compression of umbonal portion and stretching at right angles to the hinge line which is not distorted.

Figs. 5–6. *Glycymeris* sp.

5. Internal cast, x 2.

6a. Rock specimen showing two internal casts (lower left, with crenulated valve margin ; upper right, with well-preserved hinge). Nat. Size.

6b. Specimen at upper right of fig 6a, x 2.

PLATE XV.

Figs. 7–8. *Trigonia* (*Acanthotrigonia*) *phyllitica* sp. nov.

7a. Internal cast of right valve, x 1·5.

7b. External mould of right valve (counterpart of specimen of fig. 7a).

8. Cast of left valve (above is a portion of an unidentified lamellibranch valve), x 2.

Figs. 9–10. *Cardium* sp.

9. Cast of right valve showing crenulated margin and traces of slip planes of calcite which had replaced the shell, x 1·1.

10. Cast of left valve showing lateral tooth, nat. size.

Figs. 11–12. *Tibia ? morobica* sp. nov.

11. External mould of spire and internal cast of labrum, with the tip of the posterior projection missing, x 3.

12. External mould of labrum of a specimen preserved as a complete internal cast and external mould ; other parts removed to show complete outline of labrum, x 3.

All fossils from Cretaceous, Snake River, New Guinea. Originals in the collection of the Geology Department, Melbourne University. Photos by Miss M. L. Johnson.

REVISION OF AUSTRALIAN SILVER BREAMS
MYLIO and *RHABDOSARGUS*

By Ian S. R. Munro, M.Sc.

(Plates XVI–XXIII, text figures 1–5)

SUMMARY.

Six species of silver bream occur in Australian waters; five are referred to *Mylio* Lacépède and one to *Rhabdosargus* Fowler. The form from southern and south-western Australia, previously referred to *M. australis*, is described as a new species, and the first record is made of *M. latus* from Australia.

The three species *M. australis*, *M. palmaris* and *M. butcheri* sp. nov. are restricted in distribution to Australia, while *M. berda*, *M. latus* and *R. sarba* have a much wider range. The limits of distribution of Australian species closely conform with the generally accepted marine faunal regions.

INTRODUCTION.

Silver bream of the family Sparidæ are well known to the estuarine fisheries of Australia. The bream of New South Wales, Gippsland Lakes of Victoria, and Western Australia are of considerable economic importance and have been the subject of investigation by the Fisheries Division of the Council for Scientific and Industrial Research, and the Fisheries and Game Department of Victoria. This work has been in progress for some years.

It has been accepted that one species was common to these fisheries, but a few years ago when notes were compared, A. D. Butcher drew attention to differences in spawning behaviour, growth rate and colouration of the Gippsland bream from the bream inhabiting the estuaries of the east coast. This led to a thorough examination of specimens from all parts of the Australian coastline. It became evident that the bream which occurs from Mallacoota Inlet in eastern Victoria, west and north to Sharks Bay, Western Australia, was distinct from *M. australis* of the eastern coast. The new form, although described and figured in 1885 by McCoy, requires a new name. Research into the limits of the genera of the family Sparidæ has made evident the necessity to discard generic names used in the past. Several tropical breams have not been adequately described or figured and their affinities to other Indo-Pacific breams poorly understood. From a re-examination of the material in the collections of the Queensland Museum, Australian Museum, Western Australian Museum, and extensive collections from various parts of the Commonwealth, it has been possible to present a revision of the group.

GENERIC NOMENCLATURE.

Most workers have used *Chrysophrys* Quoy and Gaimard (1824) to contain *australis*, *berda*, and *sarba*. A more recent tendency has been to refer all species to *Sparus* Linné (1758). The use of either name is incorrect.

Whitley (1931) has shown that *Chrysophrys* Quoy and Gaimard refers to the pink-coloured snappers of the Indo-Pacific and Japan, namely *C. major* Schlegel (India, China, Japan), *C. auratus* (Bl. & Schn.) (New Zealand), *C. unicolor* Quoy and

Gaimard (Western Australia) and *C. guttulatus* (Cuv. and Val.) (eastern Australia). These differ notably from all other Indo-Pacific Sparidæ in dentition (text-fig. 2), and on that account in addition to characteristic pink or reddish colouration, constitute a group worthy of separate generic status. The Australian silver breams differ from this group in the more strongly molariform dentition, and they are either silvery, golden-olivaceous or dusky in colour. *Pagrosomus* Gill (1893) (Type, *Labrus auratus*, New Zealand) a synonym of *Chrysophrys* has been used instead of the latter.

The genus *Sparus* Linné (1758) was characterised by a brief latinised diagnosis of characters common to twenty-two diverse species from various parts of the world. With the recognition of many new species, the original Linnean arrangement has been split into a number of well characterised genera. The definition of these is given by Jordan and Fesler (1893), Regan (1913), Fowler (1933), and Smith (1938). Linné's conception of *Sparus* as a genus is practically equivalent to Jordan and Fesler's sub-family Sparinæ, or even the family Sparidæ as conceived by most present day workers. According to the International Commission (Opinion 69) the type of *Sparus* has been designated by Fleming as the European species *Sparus aurata* Linné. *S. aurata* possesses characters that distinguish it from all other Sparidæ; *Sparus* is thus a monotypic genus. *S. aurata* differs from Australian breams in that its anterior teeth are conical instead of incisiform (text-fig. 2), and its dorsal and anal fins have fewer rays. In addition it has more than 70 transverse series of scales, all cycloid, whereas Australian species have only 50 to 65, some of which in all species, are ctenoid. Australian forms as a whole differ sufficiently from *S. aurata* to justify their exclusion from the genus *Sparus* as now understood.

The list of genera compiled by Fowler (1933, 1936) are not all synonyms of *Sparus* Linné; only those which have *S. aurata* specifically designated as genotype should be included in synonymy. They are *Synagris* Klein (1775), *Aurata* Cloquet (1818), *Chryseis* Schinz (1822), *Dorada* Jarocki (1822), *Daurada* Stark (1828), *Chrysophris* Cuvier (1829) and *Eudynama* Gistel (1848). Cloquet used the generic name *Aurata*, also adopted by Oken (1836), for the "sous-genre" or "Les Daurades" of Cuvier (1816), a section of the Linnean *Sparus* and having *S. aurata* as type (Lesson 1829). Schinz used *Chryseis*, whilst Cuvier (1829), Voigt (1832), Griffith (1834) and Valenciennes (1836) in their respective editions substituted *Chrysophris* (not *Chrysophrys* Quoy and Gaimard) for the same genus. Gistel later proposed *Eudynama* to replace *Chrysophris* Cuvier. *Synagris* Klein includes many species and is equivalent to *Sparus* in the wide sense. On the other hand *Cynaedus* Gronow (1763) (Type, *Sparus sargus* Linné, *fide* Whitley 1929), *Pagrichthys* Bleeker (1860 C) (Type, *P. castelnaue* Bleeker), *Chrysoblephus* Swainson (1839) (Type, *Sparus gibbiceps* Cuv. and Val.[1]), and *Argyrops* Swainson (1839) (Type, *Sparus spinifer* Forskål[2]) remain distinct from *Sparus* Linné in the same sense as *Chrysophrys*, *Mylio* and *Rhabdosargus*.

[1] A well-known South African species. Included in the Australian Check-List (McCulloch 1929) based on Cannestrini (1869). Probably *Chrysophrys auratus*; *Chrysoblephus* does not occur in Australian waters.

[2] Recorded from Western Australia (Whitley 1945) and Queensland (Kent 1893).

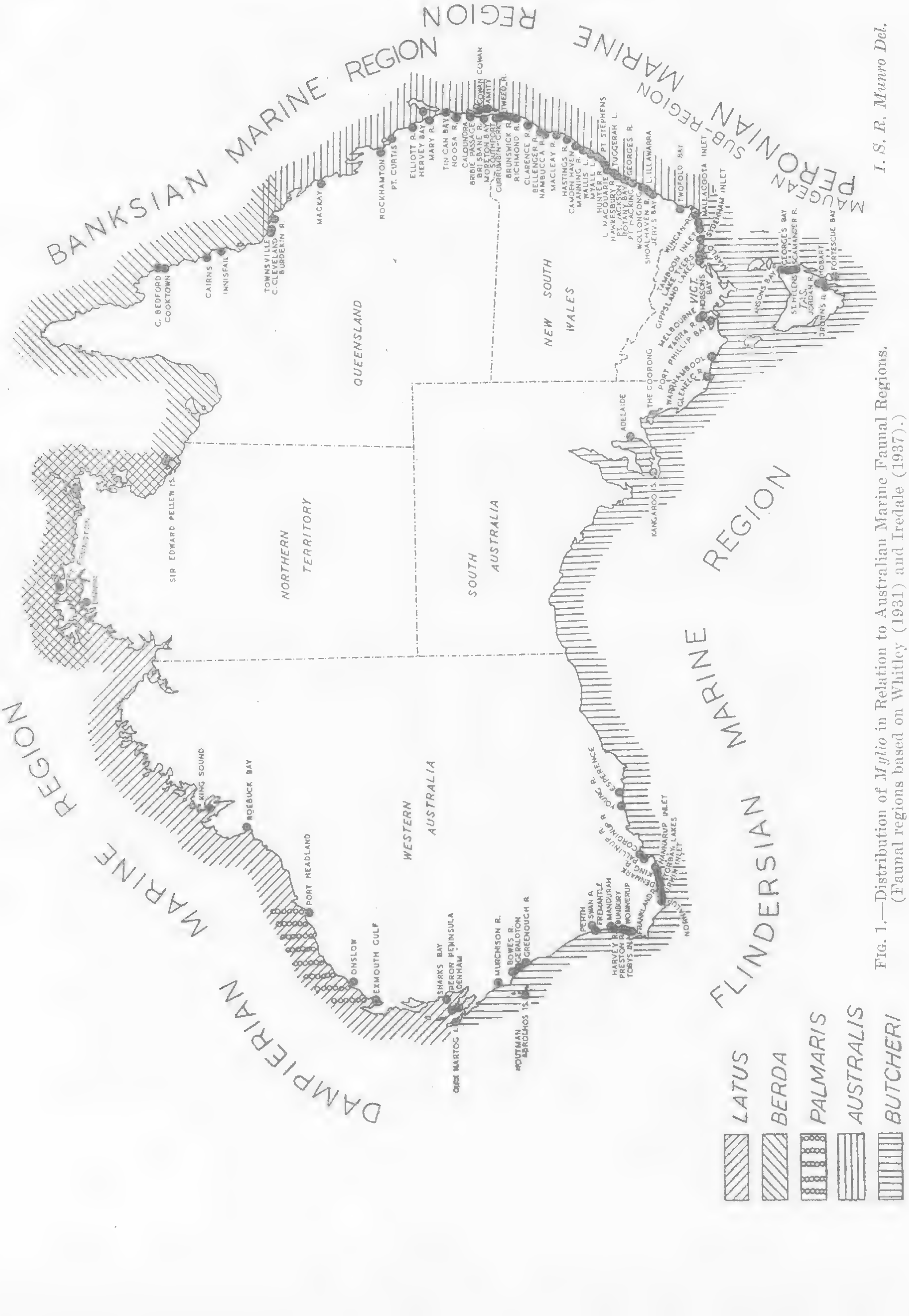


FIG. 1.—Distribution of *Mylio* in Relation to Australian Marine Faunal Regions.
(Faunal regions based on Whitley (1931) and Iredale (1937).)

I. S. R. Munro Del.

Genus *MYLIO* Lacépède, 1802.

Mylio Commerson MS, Lacépède 1802, p. 131. (Type, *Sparus mylio* Lacépède = *Chaetodon bifasciatus* Forskål, 1775.)

Caeso Gistel 1848, p. 8. (Logotype, *Sparus berda* Forskål, 1775, by designation of Jordan and Evermann 1919, p. 235.) Not *Caesio* Lacépède, 1802.

Acanthopagrus Peters 1855, p. 242. (Type, *Chrysophrys vagus* Peters, 1852, = *Sparus berda* Forskål, 1775.) *Idem* Smith 1938, pp. 236–237.

Roughleyia Whitley 1931, p. 318. (Orthotype, *Chrysophrys australis* Günther, 1859.)

Distinguished mainly by the possession of strong dorsal fin spines which appear alternately broad and narrow when viewed from one side; second anal fin spine very stout and greatly enlarged; soft dorsal and anal fins densely scaly at base; 4 to 6 anterior incisiform teeth followed by 3 to 5 series of rounded molariform teeth in each jaw, equal or subequal in size; not more than 60 series of scales along the lateral line; body scales varying from cycloid to strongly ctenoid; lateral line scales ctenoid, tubules slender, branching posteriorly and each branch terminating in a single pore; colour silvery, olivaceous or dusky, with or without cross bandings.

Restricted to Africa, Indo-Australia and Japan and includes seven species. Five occur in Australia, namely *berda* Forskål, *latus* Houttuyn, *australis* Günther, *palmaris* Whitley, *butcheri* new species. The two extralimital species are *bifasciatus* Forskål (Africa and India) and *macrocephalus* Basilewski (Japan). Although Smith (1938) tentatively included *cuvieri* Day, this has been shown (Munro, *in press*) to belong to the family Denticidæ.

In his important revision of South African Sparidæ, Smith (1938) brought to notice the neglected genus *Acanthopagrus* Peters (1855). *Acanthopagrus* was introduced by Peters unaccompanied by a definition other than that implied in the description (Peters 1852) of the type, *Chrysophrys vagus* from Mozambique, a synonym of *berda* Forskål. The characters listed by Smith accurately serve to define the limits of this group. Commerson's MS name *Mylio* was published by Lacépède (1802) in connection with *Sparus mylio* Lacépède, a synonym of *Chaetodon bifasciatus* Forskål (1775), which was referred to *Acanthopagrus* by Smith. As *bifasciatus* is the type of *Mylio*, it follows that *Acanthopagrus* is a synonym of *Mylio*.

Jordan and Evermann (1917–19) do not accept *Mylio*, claiming that Commerson's MS names are not strictly binomial, but the International Commission has formally accepted them as eligible (*Aspro* and *Antennarius*, Opinions 23 and 24; Opinion 89). *Caeso* Gistel (1848), which is not invalidated by the prior fish genus *Caesio* Lacépède (1802) (see Art. 36), was proposed as a substitute for *Chrysophrys* as used by Rüppell (1835) (viz. *Chrysophris* Cuvier, not *Chrysophrys* Quoy and Gaimard). Since Jordan and Evermann (1917–19) have designated *berda* Forskål as logotype of *Caeso*, it follows that *Caeso* is identical with *Acanthopagrus* and therefore a synonym of *Mylio*. Fowler (1933), incorrectly assuming that *aurata* was the type of *Caeso* included the latter as a synonym of *Sparus*. Whitley (1931), when removing Australian breams from *Sparus*, proposed *Roughleyia* for *australis* and *sarba*, and later (Whitley 1935) added *palmaris*. As *australis* Günther (1859) is orthotype of *Roughleyia*, and is to be referred to the same genus as *bifasciatus* and *berda*, it follows that *Roughleyia* also is a synonym of *Mylio*.

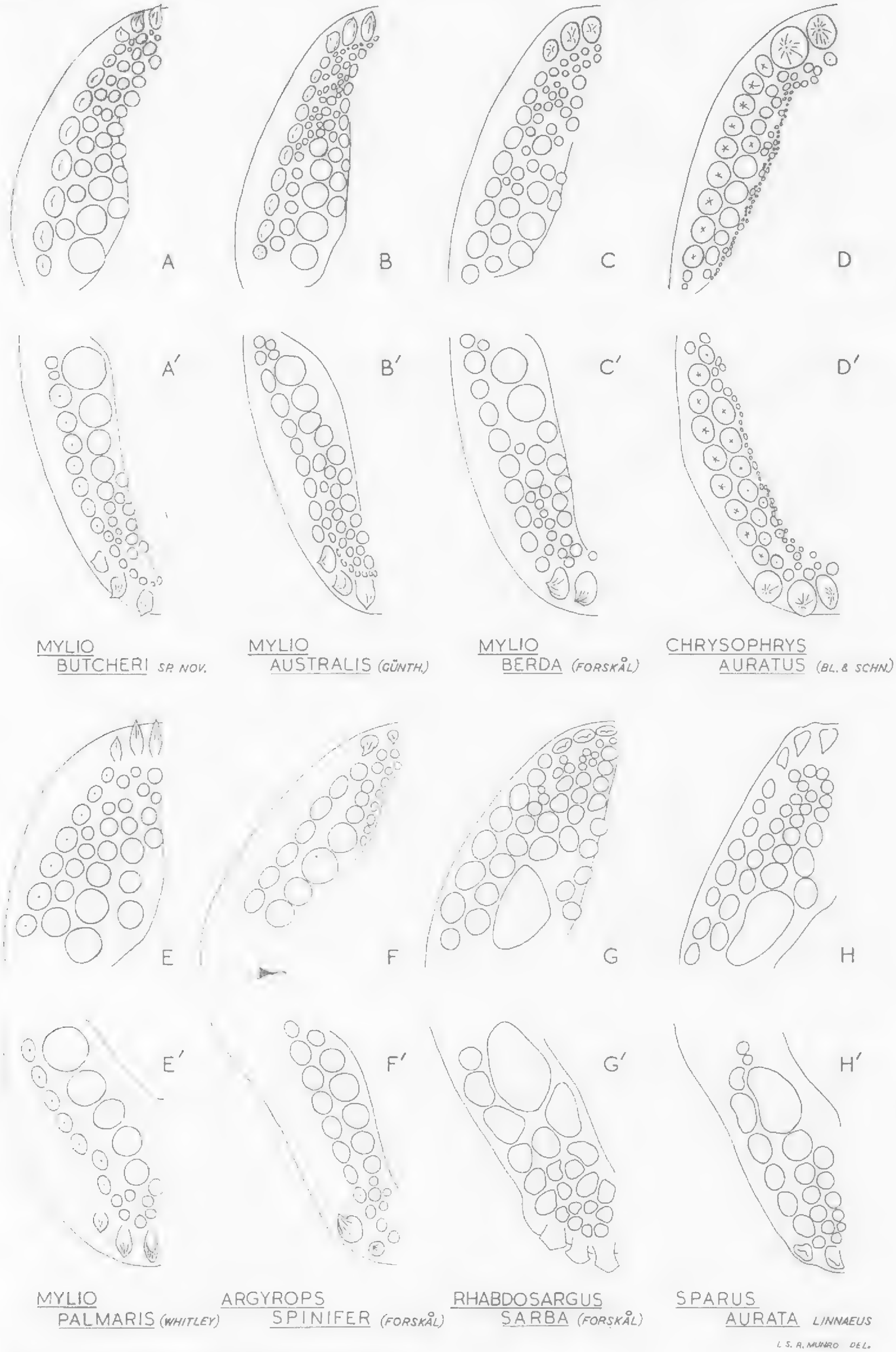


FIG. 2.—Dentition of Australian Sparidae—

A, A′—*Mylio butcheri* sp. nov. (Gippsland Lakes). B, B′—*Mylio australis* (Günther) (Noosa River). C, C′—*Mylio berda* (Forskål) (Townsville). D, D′—*Chrysophrys auratus* (Bl. & Schn.) (Moreton Bay). E, E′—*Mylio palmaris* (Whitley) (Exmouth Gulf). F, F′—*Argyrops spinifer* (Forskål) (Piper Island). G, G′—*Rhabdosargus sarba* (Forskål) (Queensland). H, H′—*Sparus aurata* Linné (Mediterranean Sea, after Boulenger 1910).

Right hand sides only. A–H upper jaws, A′–H′ lower jaws.

Genus *RHABDOSARGUS* Fowler, 1933.

Rhabdosargus Fowler 1933, p. 178. (Orthotype, *Sargus auriventris* Peters, 1855, = *Sparus sarba* Forskål, 1775.)

Austrosparus Smith 1938, p. 241. (Orthotype, *Chrysophrys globiceps* Cuvier and Valenciennes 1830.) *Idem* Smith 1942, pp. 280–281.

Distinguished from *Mylio* by having the dorsal and anal fin spines slender to moderate; second spine of anal fin slender and not greatly larger than the third; soft dorsal and anal fins without scaly sheaths at base; 4 to 6 (upper jaw) and 4 to 8 (lower jaw) anterior incisiform teeth, followed by 3 or more series of molariform teeth with rounded crowns, one inner posterior of which is greatly enlarged; 50 to 65 series of scales along the lateral line; lateral line scales and those above cycloid, others reduced ctenoid; tubules of lateral line scales broad, with posterior double diverging series of pores.

Restricted to Africa, Indo-Australia and Japan and includes the three species, *sarba* Forskål (Australia, Africa to Japan), *tricuspidens* Smith (Africa) and *globiceps* Cuvier and Valenciennes (Africa).

Fowler (1933) erected *Rhabdosargus* as a monotypic sub-genus of *Diplodus* Rafinesque for *Sargus auriventris* Peters. This species has been accepted by Smith (1942) as a synonym of *sarba* Forskål. It follows that *sarba* is virtually the genotype of *Rhabdosargus*. Smith (1938) showed that *sarba* is not even sub-generically distinct from *globiceps*, the orthotype of *Austrosparus* Smith (1938), hence *Austrosparus* is a synonym of *Rhabdosargus*. Unfortunately Smith (1938) has confused the nomenclature by retaining *Rhabdosargus* as a sub-genus of *Austrosparus*. He should have used *Rhabdosargus* as his new genus and as a sub-genus for *auriventris*. *Austrosparus* is not available even as a sub-genus for *globiceps* and *sarba*.

The species recorded as *auriventris* by Smith (1938) (*non* Peters) has been named *tricuspidens* by the same author (1942) with *Prionosparus* as the sub-generic name.

KEY TO THE AUSTRALIAN SILVER BREAMS.

1. One enlarged molar posteriorly in each jaw; not less than 7 rows of scales above lateral line; not less than 13 dorsal and 11 anal rays; head broadly convex or sharply angular. .... *Rhabdosargus sarba.*

2. No single greatly enlarged molar posteriorly; 4 to 5 rows of scales above the lateral line; not more than 12 dorsal and 9 anal rays; head profile straight or gibbous at eyes.

   A. Body colour dusky grey or black without longitudinal streaks; ventral and anal fins dusky; lateral line highest under 6th or 7th dorsal spine; not more than 4 scale rows above lateral line.

      a. Head profile straight, not tumid at nape; caudal fin tips rounded; 3 or 4 rows of molars on each side of lower jaw. .... *Mylio berda.*

      aa. Head profile deeply notched above eyes, tumid at nape; caudal fin tips sharp; 2 rows of molars on each side of lower jaw. .... *Mylio palmaris*

B. Body colour light silver-grey to gold-olivaceous with longitudinal streaks along scale rows; ventral and anal fins yellow or brown; lateral line highest under 3rd to 5th dorsal spine; 4 or 5 scale rows above lateral line.

b. Head profile gibbous at eye; no black spot in axil of pectoral fin. . . . . *Mylio latus*.

bb. Head profile not gibbous at eye; prominent black spot in axil of pectoral fin.

i. 52 scales in lateral line, 12 rows below; lateral line with sharp dip anteriorly; anal and ventral fins yellow; ventral rays extend more than three quarters distance to anus. . . . . *Mylio australis*.

ii. 55 scales in lateral line, 15 rows below; lateral line without inflection anteriorly; anal and ventral fins brown; ventral rays extend less than three quarters distance to anus . . . . *Mylio butcheri*.

MYLIO AUSTRALIS (Günther), 1859.

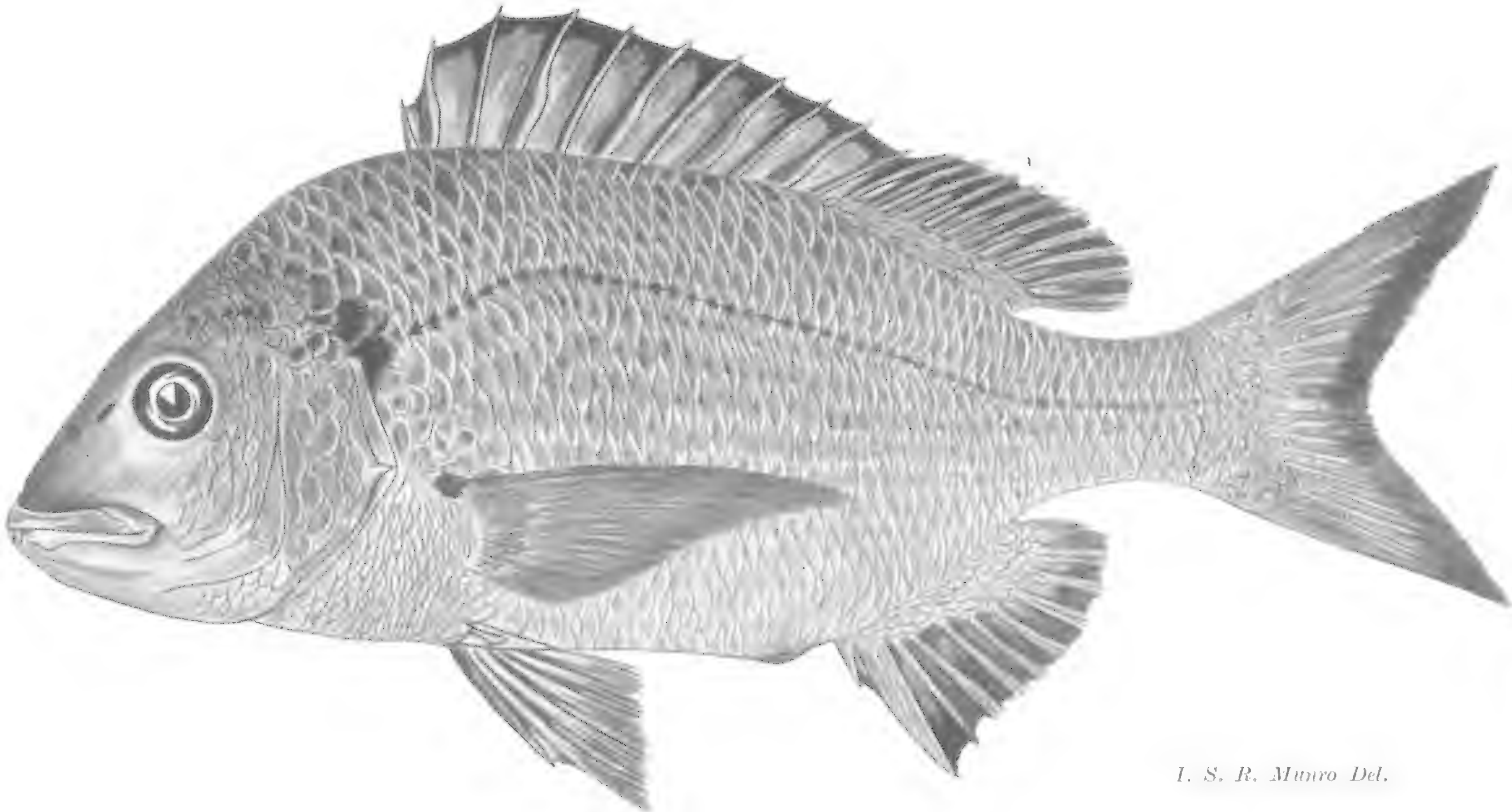
Yellow-fin Bream.

(Plates XVI, XXII, and XXIII.)

Distribution.—Endemic to Australia and restricted to the east coast of Queensland, New South Wales and Victoria between latitudes 19° S. and 38° S. This corresponds with the Peronian Marine Region, but includes the southern half of the Banksian Marine Region (text-fig. 1). The most northerly specimens seen came from Townsville. The southerly limit is Mallacoota Inlet, but occasional specimens occur with *butcheri* in the Gippsland Lakes. Essentially estuarine in habit, it occurs in coastal rivers, creeks, lakes and bays where marine to brackish conditions exist. In dry seasons this species moves up rivers as far as the fresh water barrier. During freshets and in the spawning season it moves down the rivers to the sea and is captured by net and rod fishermen along retaining walls and ocean beaches. During the spawning season, when frequenting river mouths, it is known as "Sea Bream" or "Surf Bream." Other vernaculars are "Black Bream" (New South Wales) and "Bream" (Queensland). The yellow-fin bream represents 6 to 12 per cent. of the total fish marketed in Brisbane and 5 to 7 per cent. of the total annual commercial catch of New South Wales. It is a popular angling species.

Size.—Does not attain great size; examples weighing more than 3 pounds are uncommon. A record specimen from Georges River, New South Wales, weighing 7 pounds 4 ounces and measuring 22 inches (560 mm.) (McCulloch 1928) is represented by a cast in the Australian Museum. The Queensland Museum has a specimen from Southport (I.6094) measuring 20 inches total length and weighing 5 pounds 11 ounces. G. P. Whitley noted a specimen from Clarence River that measured 23 inches and weighed 7 pounds 2 ounces. Stead (1906) recorded examples 4 pounds 14 ounces and 5 pounds 12 ounces (20 inches). Growth rate is slower than in *butcheri*, being 3 inches first year, 1¾ to 2 inches second to fourth year, 1 inch or less per year in older fish (length to tail fork).

Colour.—Individual colouration varies in relation to habitat. "River Bream" caught upstream in dark water amongst weeds and snags are dark, golden-bronze to brown-green. "Sea Bream," travelling fish inhabiting the zone near river mouths or along ocean beaches over a bottom of white sand, are paler and silvery. Average specimens have the back and sides golden-olivaceous, turning to dull grey



I. S. R. Munro Del.

PLATE XVI.—Yellow-Fin Bream. *Mylio australis* (Günther).
Specimen from Sydney Fish Market. Length, 325 millimetres.

when preserved ; back marked with indistinct broad vertical bands of brown-grey, apparent only in freshly caught adults and prominent in post-larvals (Munro 1945A) and younger age groups ; longitudinal scale rows of back marked with gold streaks ; belly and chin pale silvery ; golden patches on snout, interorbital and maxillary ; operculum dusky ; dorsal fin spines silvery, rays hyaline, membrane dusky with black blotching and black margin ; anal fin spines yellowish, rays hyaline, membrane canary yellow ; ventral fin rays and membrane canary yellow ; pectoral fin olivaceous ; caudal fin olivaceous or yellowish, with broad black margin ; intense black spot in pectoral axilla ; large diffuse dusky blotch at origin of lateral line. The Australian Museum has a partial albino specimen (IA 3494) in which the head and body are silvery-pink. Normal dark pigmentation is present only on inter-, post-, and suborbital regions of head and as two broad oblique grey bands across the antero-dorsal sector of body ; belly silvery ; caudal and dorsal fins pinkish with narrow black margins ; ventral and anal fins canary yellow.

FIN FORMULA (Table I).—On the basis of fin formulæ it is impossible to distinguish *australis* from other Australian species of *Mylio*. The last ray in both dorsal and anal fins is easily missed as it is small and joined to the preceding ray. Dorsal rays usually number 11 + i, counted as 12 ; anal rays 8 + i, counted as 9.

Range of variation.—D. (X-XII) + (10–13) ; A. III + (8–10) ; V. I + 5 ; P. 14–16 ; C. 18–23.

Modal formula.—D. XI + 12 ; A. III + 9 ; V. I + 5 ; P. 15 ; C. 20.

BODY PROPORTIONS.—Ratios of body parts of specimens representing a wide range in size and locality, are summarised as means and ranges of variation (Table IV). Anterior profile of head steep, straight, slightly convex at eye. Suborbital variable, usually greater than eye. Snout equal to or slightly greater than maxilla which extends beyond anterior border of eye, usually to below first third of diameter. Ventral profile of head continued as almost straight line to anus. Dorsal fin originates above or just behind posterior edge of opercle ; first spine shortest, equals half second spine ; fourth spine longest, greater than dorsal rays including basal sheath. Anal fin commences under third ray of dorsal ; first spine shortest ; second spine longest, strongest, greater than anal rays or dorsal spines, surface sculptured, longer than in *butcheri*, stronger than in *latus* or *butcheri* ; third spine shorter and weaker than second. Scaly sheaths of dorsal and anal fins equal 3 or 4, 2 or 3 respectively in exposed parts of rays. Pectoral fin extends to origin of soft dorsal. Ventral fins originate under or just posterior to spinous dorsal origin, extending about seven-eighths of distance to anus. Caudal fin longer than in *butcheri*.

SCALES (Table II).—Lateral line scales, including 5 to 8 on caudal base, vary from 47 to 58, but 87 per cent. of individuals have 50 to 55, and the mean count in 128 fishes is 52 (*butcheri* 55, other species 50). Lateral line reaches greatest height under 4th or 5th dorsal spine and has sharp inflection anteriorly. Most specimens (81 per cent.) have 5 rows of scales above lateral line, 16 per cent. have 4 rows (tropical specimens), few have 6. Scales below lateral line vary from 11 to 15, but 90 per cent. of individuals have 12 or 13. Preopercle with 5 or 6, opercle with 4 or 5 rows. Basal sheaths of dorsal, anal and caudal fins well developed, wider than in *butcheri*, narrower than in *berda*.

Scales above lateral line cycloid, rarely with few degenerate spines. Scales below lateral line (Plate XXII, fig. 1) strongly ctenoid ; ctenoid margin 0·25 to 0·35 millimetres wide, 4 or 5 (rarely 3) series of spines, outermost only with entire points ; anterior margin crenulate with 10 to 16 radii. Lateral line scales (Plate XXIII, fig. 1) feebly ctenoid ; posterior margin indented ; tubule strangulated, narrow, bifurcating posteriorly with each arm secondarily branched and terminating in a single pore ; normally 4 pores, 5 or 6 in some, 2 in young.

GILL-RAKERS (Table III).—Dorsal limb of first arch usually bears 5 to 9, ventral limb 7 to 12, and total count 13 to 19. Modal formula is $7 + 9 = 16$.

TEETH.—Six curved peg-like incisors in front of both jaws. Molars in 4 or 5 series on each side of upper jaw, and in 3 or 4 series on each side of lower jaw ; with bluntly rounded crowns ; small anteriorly becoming progressively larger posteriorly. Largest molars form third row from periphery in upper jaw and innermost row in lower jaw. Minute molars form a villiform patch behind incisors. Molars of outer series in both jaws slightly flattened laterally, subconical. Pattern typical of *Mylio*. (Text-fig. 2, B and B′). Dentition tritorial.

REFERENCES TO SPECIES IN LITERATURE.

Chrysophrys australis Günther 1859, p. 494 *partim* (Pt. Jackson–Type Locality) ; Steindachner 1866, p. 433 *partim* (Pt. Jackson) ; Cannestrini 1869, p. 151 ; Schmeltz 1869, p. 151 (Mackay, Rockhampton) ; 1874, p. 24 ; 1879, p. 41 ; Castelnau 1879, p. 350 (Pt. Jackson) ; Klunzinger 1880, p. 33 *partim* (Cleveland Bay) ; Günther 1880, p. 33 (Mary R.) ; Macleay 1881, p. 119 *partim* (Pt. Jackson); Tenison-Woods 1882, p. 42 *partim*, pl. 9 (Pt. Jackson) ; Ogilby 1886, p. 19 (Pt. Jackson) ; Kent 1889, p. 3, pl. 7 ; Cohen 1892, p. 15 ; Kent 1893, p. 285 ; Ogilby 1898, p. 129 (Sydney) ; Waite 1899, p. 82 (Pt. Stephens) ; Cox et alia 1902, p. 5, pl. (Pt. Hacking) ; Tosh 1903, p. 21, pl. 10 (Moreton Bay) ; Waite 1904, p. 34 ; Stead 1906, p. 125, fig. 47 (L. Macquarie) ; 1907, p. 23 ; 1908, p. 77, pl. 46 (L. Macquarie) ; 1910, p. 8, pl. 3 (Wallis L., Tuggerah L., Botany Bay, Hawkesbury R., Pt. Hacking) ; 1911, p. 6.

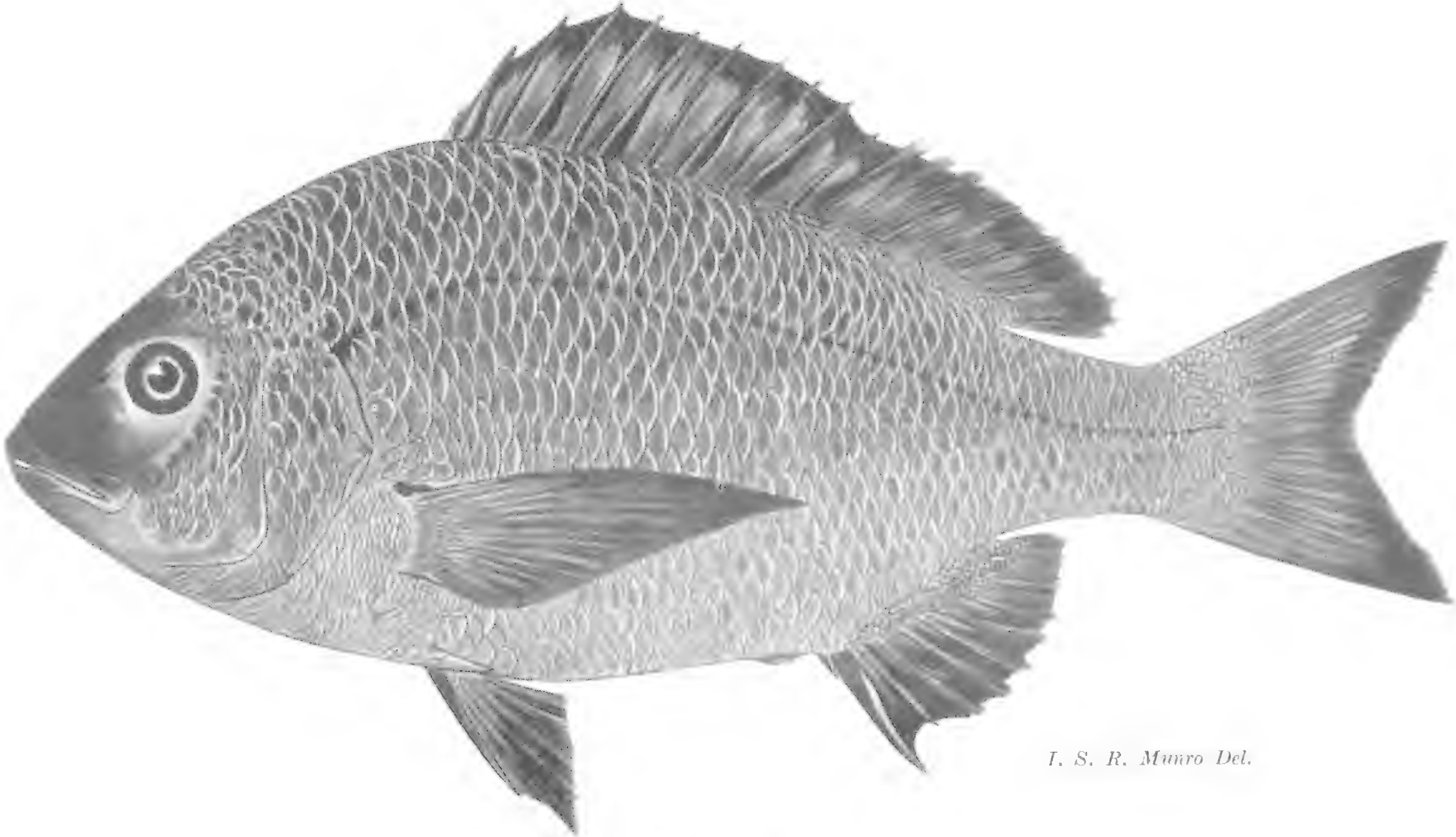
Sparus australis Ogilby 1915, p. 26 (Tweed R.) ; Roughley 1916, p. 134 *partim*, pl. 43 ; Ogilby 1918, p. 105 (Caloundra) ; McCulloch 1922, p. 88 ; McCulloch and Whitley 1925, p. 155 ; Phillipps 1927, p. 130 ; Fowler 1928 A, p. 218 *partim* ; McCulloch 1929, p. 231 *partim* ; Fowler 1933, p. 151 (Pt. Jackson) ; McCulloch and Whitley 1934, p. 61 ; Weber and Beaufort 1936, p. 469 *partim*.

Pagrus australis Ogilby 1893, p. 51 *partim* (Twofold Bay, Wollongong, Shell Harbour, Pt. Jackson, Lake Macquarie, Clarence R.) ; Waite 1898, p. 26 (Pt. Stephens) ; Dannevig 1903, p. 61.

Roughleyia australis Whitley 1931, p. 318 (Pt. Jackson) ; 1935, p. 235 ; Kesteven and Serventy 1941, p. 171 *partim* ; Kesteven 1942, p. 53 (Caloundra) ; Coun. Sci. Ind. Res. 1944, p. 44.

Acanthopagrus australis Smith 1938, p. 237 ; Coun. Sci. Ind. Res. 1945, p. 82 (Noosa R., Bribie Passage) ; Munro 1945 A, p. 136, fig. 1 (Noosa R., Bribie Passage, Bellinger R., Nambucca R., L. Macquarie) ; 1945 B, p. 2 ; Fairbridge 1946, p. 8, fig. 1; Whitley 1947, supplm.

Among extra-limital locality records are Melanesia and New Zealand. DeVis's (1883) record from Api, New Hebrides, the basis of Fowler's (1928 A) Melanesian record, probably refers to *berda*. Fowler (1933) incorrectly assumed that *Pagrus micropterus* and *P. ciliaris* Richardson (1843) were synonyms of *australis* ; the latter is not known to occur in New Zealand. Many Australian references to *australis* refer to *butcheri* sp. nov. Günther (1859) included in his original description at least two species since his material (dried skins) came from Pt. Jackson, Harvey R. (W.A.),



I. S. R. Munro Del.

PLATE XVII.—Southern Bream. *Mylio butcheri* sp. nov.
Holotype, Australian Museum Reg. No. IB 1895, from Gippsland Lakes. Length, 285 millimetres.

Pt. Essington (N.T.) and other localities. Since Whitley (1931) designated Pt. Jackson as type locality for *australis* Günther, this name must be reserved for the bream of the east coast of Australia. It is doubtful whether *australis* extends far into the tropics. Günther's skin collected by H.M.S. " Fly " at Pt. Essington and Rendahl's (1922) fish from Darwin probably refer to *latus* or *berda*. There are no examples of *australis* from Northern Territory in the collections of Museums throughout Australia. Ogilby's (1893) inclusion of New Guinea in the distribution has been followed by subsequent authors but the record appears to be without basis.

MATERIAL.—*Queensland Museum*—I 389 (Tweed R.), I 979 (Moreton Bay), I 2160 (Cowan Cowan), I 3196 (Amity), I 4250 (Brisbane R.), I 4946 (Sandgate), I 6094 (Southport), I 5624, 5733 (C. Cleveland), I 7546 (Townsville). *Australian Museum*—IA 3494, 6493, I 4445, 9553, 9555–8, 9636, 9687 (Pt. Jackson), IA 548 (Bondi), I 4591–3 (Parramatta R.), I 4446, I 4986 (Pt. Hacking), I 12752 (Pt. Stephens), IB 594 (Tuggerah L.), I 3337 (L. Macquarie), IA 7971 (Noosa R.), IA 3941 (Rat Is., Q.), I 15281 (unlocalised). *Other Material*—Townsville, Elliott R., Hervey Bay, Mary R., Tin Can Bay, Noosa R., Bribie Passage, Moreton Bay, Southport, Currumbin Crk., Tweed R., Brunswick R., Richmond R., Clarence R., Bellinger R., Nambucca R., Macleay R., Hastings R., Camden Haven, Manning R., Wallis L., Myall L., L. Macquarie, Tuggerah L., Hawkesbury R., Pt. Hacking, L. Illawarra, Shoalhaven R., Jervis Bay.

MYLIO BUTCHERI sp. nov.

Southern Bream.

(Plates XVII, XXII, and XXIII.)

DISTRIBUTION.—Endemic to Australia and restricted to the temperate waters of the southern and south-western coastlines between latitudes 26° S. (west coast), 37° S. (east coast) and 43° S. (Tasmania), comprising southern Victoria, Tasmania, South Australia and south-west Western Australia. This corresponds with the Flindersian Marine Region (Adelaidean of Hedley), and includes the Maugean Sub-region of the Peronian Fauna (Text-fig. 1). On the east it is slightly overlapped by *australis* in eastern Victoria, but normally it does not occur north of Mallacoota Inlet. In the west it occurs south of Sharks Bay in which locality it is replaced to the north by *latus*, and on the south coast it ranges east at least to Esperance Bay. In the east it occurs in the estuarine systems of the southern coasts of Victoria and South Australia and south to Kangaroo Island and Tasmania, but is not abundant in either South Australia or Tasmania. The apparent break in distribution in the area of the Great Australian Bight may be artificial owing to lack of material. Essentially estuarine to fluviatile in habit, it is practically restricted to the brackish water of coastal lakes and rivers. In Victoria at least, normally it does not move out of estuaries even during the spawning season and is not caught along ocean beaches[3]. The species remains upstream in sheltered waters of low salinity to spawn. In south-west Western Australia it has been known to reproduce in coastal lakes that have been cut off from the sea for long periods. Usually it is known as " Bream " (Victoria, South Australia, Tasmania), " Black Bream " (Western Australia, South Australia) or " Silver Bream " (Tasmania). " Blue-nosed Bream " is used by anglers and professional fishermen when speaking of older and larger fish (over 2 pounds) as

[3] A. D. Butcher records the migration of one tagged specimen from Sydenham Inlet to Marlo.

they often have a bluish sheen, particularly around the snout. It represents on the average 10 per cent. of the total annual fish catch marketed in Victoria since 1911. The Gippsland Lakes, the largest producing centre, marketed 955,000 pounds in 1919, but the catch has declined by 95 per cent. during the subsequent 25 years. The Southern Bream is also of economic importance in Western Australia, but it is not marketed extensively in Tasmania or South Australia. It is popular with anglers, particularly in Victoria, due to sporting and table qualities.

SIZE.—Grows to a larger size at a faster rate than *australis*. Large examples are reasonably common in Gippsland Lakes, many weighing up to 4 pounds are obtained. The known record is represented by a mounted specimen in the Melbourne Office of the Victorian Fisheries and Game Department, obtained at Lake Tyers in 1918, weighing 7 pounds $6\frac{1}{2}$ ounces and measuring 21·5 inches (545 mm.) in total length. Butcher (1945 A, 1945 B) showed the average growth rate as $4\frac{3}{4}$ inches during the first year and $3\frac{3}{4}$ inches per year during second and third years. A total length of 13 inches is thus obtained by the end of three years, and growth during two years is approximately equal to that of *australis* during three years.

COLOUR.—Distinguished from *australis* by the dark brown ground colour of body and lack of canary yellow on ventral and anal fins. McCoy (1885) gave an excellent description and figure. In freshly caught specimens, back and sides are predominantly gold-brown or bronze with greenish reflections; back lacking vertical dusky bands; longitudinal scale rows of back marked with gold streaks; belly and chin white with pearl-grey shadings on scales and some reflections of gold and pink; head with tints of purple and blue, particularly around snout and cheeks; iris golden; operculum and preoperculum with reflections of gold and copper-red; dorsal fin spines brown, rays hyaline, membrane grey with mottling of purple, blue and gold and with intensely dark margin; anal fin spines white with grey-brown shading, rays hyaline or yellowish, membrane white with much dusky brown-grey shading; ventral fin spines and membrane white with brown-grey shading, rays hyaline to yellowish; pectoral fin brownish; caudal fin dusky-olivaceous or brown, with gold reflections and dark margin; prominent black spot in pectoral axilla; intensely dark scale at origin of lateral line. Preserved specimens are uniformly dusky grey, very dark dorsally, lighter ventrally.

FIN FORMULA (Table I).—Material from Victoria, Tasmania, South Australia, Western Australia, considered separately, exhibits similar modes and ranges of variation for each count. On the basis of fin counts, the species appears homogeneous throughout its range and cannot be distinguished from other species of *Mylio*. The last ray in both dorsal and anal fins is small and united to the preceding ray.

Range of variation.—D. (X–XIII) + (10–13); A. III + (8–10); V. I + 5; P. 14–16.

Modal formula.—D. XI + 12; A. III + 9; V. I + 5; P. 15.

BODY PROPORTIONS.—Ratios of specimens representing a wide size range and constituting a combined sample from Victoria, South Australia, Tasmania (eastern stock) and Western Australia (western stock), are summarised as means and ranges of variation (Table IV). Data from each state, treated separately, agree

closely as regards means, maxima and minima for each ratio. Comparison of mean values for each ratio in *butcheri* and *australis* indicates some slight differences especially in head proportions and lengths of anal fin spines and rays. The most obvious difference concerns the length of the caudal fin ; tail length representing perpendicular distance from hypural to line joining tail tips is shorter in *butcheri* (5·41) than in *australis* (4·14). Anterior profile of head steep, slightly convex between snout and nape ; adults without protuberance at eye, but young sharply angular with strong protuberance at eye as in *latus*. Suborbital variable, usually greater than eye. Snout equal to maxilla which usually extends to below middle of eye. Ventral profile between snout tip and anus strongly convex, giving head more pointed appearance than in *australis*. Dorsal fin originates a little behind posterior edge of operculum ; first spine shortest, less than half second ; fourth spine longest, longer than dorsal rays including basal sheath. Anal fin commences under 2nd to 4th dorsal ray ; first spine shortest ; second longest and strongest, longer than anal rays, approximately equal to longest dorsal spine, with surface sculptured in old specimens ; relatively shorter and weaker than in *australis* ; third spine shorter but equally as strong as second. Scaly sheaths of dorsal and anal fins poorly developed, equal 6 or 7, 4 or 5 respectively in exposed parts of rays. Pectoral fin may extend to origin of soft anal, but more often reaches little further than first spine of anal fin. Ventral fins originate under or slightly behind first dorsal spine, extending no further than three quarters of distance to anus. Caudal fin shorter than in *australis* and emargination relatively more shallow.

Scales (Table II).—Material from Victoria, Tasmania, South Australia, Western Australia, considered separately, exhibits similar modes and ranges of variation for each count. Lateral line scales, including about 6 on caudal base, vary from 50 to 62, but 93 per cent. of individuals have 52 to 58, and the mean count in 187 specimens is 55. The modal count is greater than in *australis* (52) and other Australian species of *Mylio* (50). It is a useful diagnostic character. Lateral line reaches greatest height under 4th dorsal spine, but is more evenly arched and lacks the anterior inflection of *australis*. Most specimens (98 per cent.) have 5 scale rows above lateral line, odd specimens have 6 rows. Scales below lateral line vary from 13 to 17 but 79 per cent. of individuals have 15 or 16. This count is also diagnostic as all other Australian species of *Mylio* have 13 or fewer rows. Preopercle with 5 or 6 (sometimes 4) rows. Opercle with 4 or 5 (sometimes 6) rows. Basal sheaths of dorsal, anal and caudal fins poorly developed.

Scales above lateral line cycloid or weakly ctenoid ; ctenoid spines restricted to centre of exposed margin. Scales below lateral line (Plate XXII, fig. 2) strongly ctenoid ; ctenoid margin 0·20 to 0·35 millimetres wide (usually not greater than 0·30 millimetres), 3 or 4 (rarely 5) series of spines, outermost only with entire points ; anterior margin crenulate with 10 to 16 (usually 12 to 14) radii. Ctenoid spines variable in shape, usually bulbous basally with acute tip ; shorter and broader than in *australis*. Lateral line scales (Plate XXIII, fig. 2) feebly ctenoid ; posterior margin indented ; tubule strangulated, narrow, bifurcating posteriorly with each arm secondarily and irregularly branched, each terminating in a single pore ; normally 4 to 6 pores, never less than 4 ; 6 common even in young specimens. Scales differ from those of *australis* in having a wider ctenoid margin containing an additional series of spines. The double bifurcation of the lateral line tubules distinguish *butcheri* from other species except *australis*.

GILL-RAKERS (Table III).—Dorsal limb of first arch usually bears 5 to 8, ventral limb 7 to 11, total count 13 to 18. Modal formula is $7 + 9 = 16$, which is identical with that of *australis*. Material from Victoria, Tasmania, South Australia and Western Australia, considered separately, exhibits similar modes and ranges of variation for each count.

TEETH.—Six curved peg-like incisors in front of both jaws. Molars in 4 or 5 series on each side of upper jaw, and in 3 or 4 series on each side of lower jaw with bluntly rounded crowns ; small anteriorly, becoming progressively larger posteriorly. Largest molars form third row from periphery in upper jaw and innermost row in lower jaw. Minute molars form a villiform patch behind incisors. Molars of outer series in both jaws slightly flattened laterally, subconical. Pattern typical of *Mylio* (Text-fig. 2, A and A′). Dentition tritorial.

REFERENCES TO SPECIES IN LITERATURE.

Chrysophrys australis Günther 1859, p. 494 *partim* (Harvey R., W.A.) ; Steindachner 1866, p. 434 *partim* (Hobson's Bay) ; Klunzinger 1872, p. 21 (Hobson's Bay) ; Castelnau 1872, p. 71 (Melbourne, Yarra R., Gippsland Lakes) ; 1873 C, p. 130 (Fremantle) ; Klunzinger 1880, p. 33 *partim* (Hobson's Bay) ; Macleay 1881, p. 119 *partim* (Pt. Phillip) ; Tenison-Woods 1882, p. 42 *partim* (Glenelg R.) ; Johnston 1882, p. 69, 111 (Browns R., Jordan R., Scamander Bay, Georges Bay) ; McCoy 1885, pl. 4 and text (Gippsland Lakes, Mordialloc Crk., Hobson's Bay) ; Lucas 1890, p. 20 ; Stead 1906, p. 125, 263 *partim* ; Fowler 1923, p. 144 (Melbourne).

Chrysophris australis Castelnau 1873 B, p. 10 (Melbourne).

Sparus australis McCulloch 1912, p. 89 (Fremantle) ; Roughley 1916, p. 134 *partim* ; Waite 1921, p. 109, fig. 167 (South Australia) ; 1923, p. 32, fig. ; Lord and Scott 1924, p. 63, fig. (Tasmania) ; McCulloch 1929, p. 231 *partim* ; Fowler 1929 B, p. 644 (Melbourne) ; Rudall, Hale and Sheridan 1935, p. 40 (Adelaide) ; Mack 1941, p. 8, 104 (Gippsland Lakes).

Pagrus australis Ogilby 1893, p. 51 *partim*.

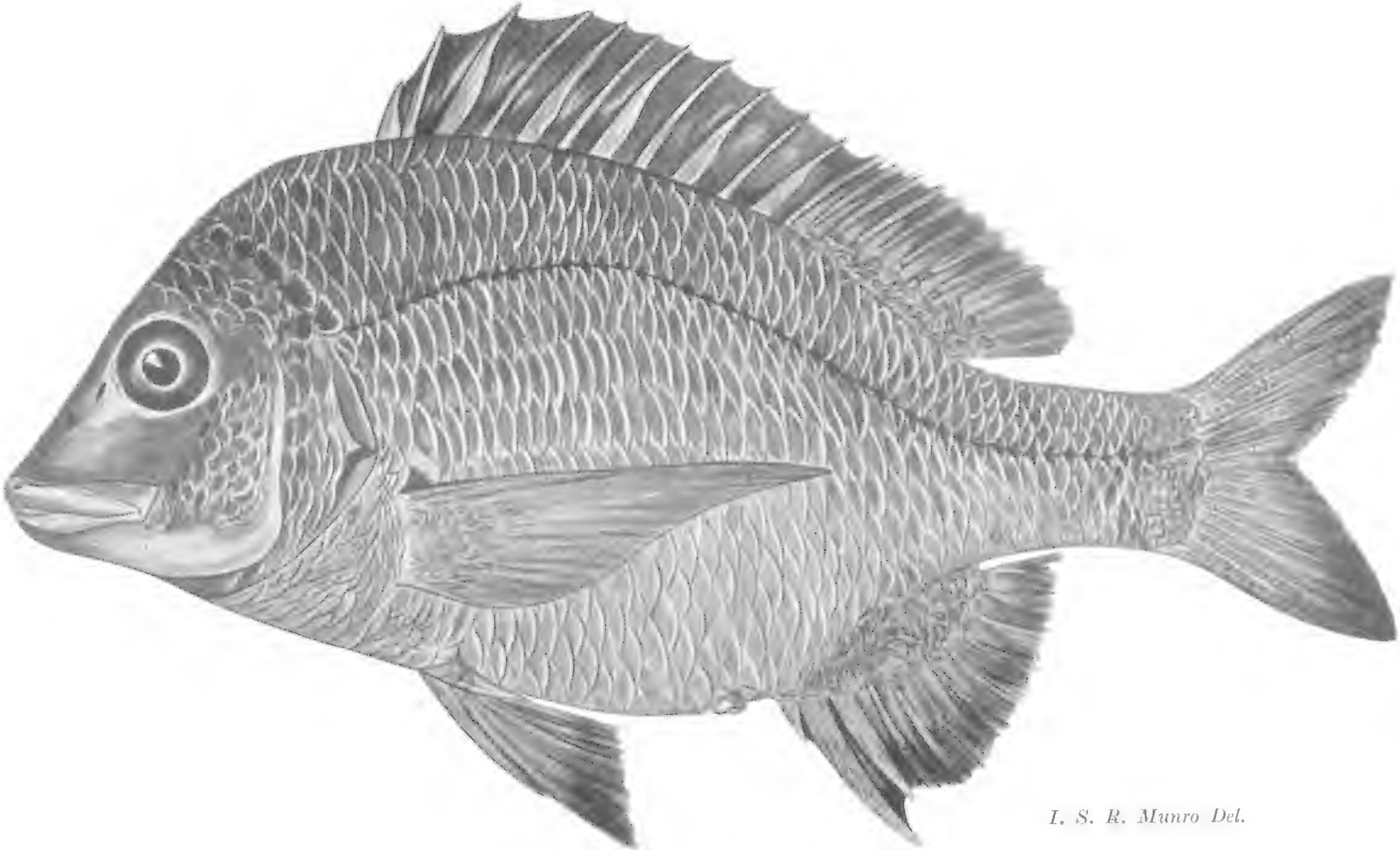
Roughleyia australis Kesteven and Serventy 1941, p. 171 *partim*.

Acanthopagrus sp. Whitley 1947, supplm.

As Whitley (1931) designated Port Jackson, a locality outside the range of the southern bream, as the type locality of *australis*, Günther's name can apply only to the yellow-fin bream of the east coast, and a new name is needed for the southern form. It is named in honour of *A. D. Butcher* who has made an extensive study of its economic biology in the Gippsland Lakes (Butcher 1945 A, 1945 B). There are no extra-limital records.

MATERIAL.—*Queensland Museum*—Paratypes I 7721 (300 mm.), I 7722 (246 mm.) (Gippsland Lakes). *Australian Museum*—Holotype IB 1895 (264 mm. Gippsland Lakes), Paratype IB 1896 (327 mm., Gippsland Lakes), I 13157 (Sharks Bay), I 12231–2 (Fremantle), I 14149 (Hobart), I 7563–4 (Melbourne Market). *Western Australian Museum*—P2815 (Young, Houtman's Abrolhos Is.), 2 unlocalised specimens (? same locality). *C.S.I.R. Marine Biological Laboratory*—11 Paratypes (229–320 mm., Gippsland Lakes), 6 specimens (119–216 mm., Kangaroo Is.), 3 specimens (191–336 mm., St. Helens), 3 specimens (213–245 mm., Mandurah), 6 specimens (138–149 mm., Pallinup R.), 23 specimens (77–137 mm., Greenough R.). *Other material*—Murchison R., Bowes R., Nannarup, Esperance (notes, ex G. P. Whitley) ; Murchison R., Bowes R., Mandurah (Peel Inlet), Bunbury, Preston R., Bussleton (Wonnerup Inlet), Toby's Inlet, Frankland R. (Nornalup Inlet), Irwin Inlet, Denmark (Wilson's Inlet), Torbay Lakes, King R., Nannarup Inlet (Taylor's Inlet), Cordinup R., Young R. (Fanny Cove), Wingan Inlet (scales only).

The Holotype (Plate II) is lodged with the Australian Museum. Paratypes in the Australian Museum and Queensland Museum. Type locality, Gippsland Lakes, Victoria.



I. S. R. Munro Del.

PLATE XVIII.—Tropical Black Bream. *Mylio berda* (Forskål).

Queensland Museum Reg. No. I 5982, from Cape Cleveland. Length, 258 millimetres.

MYLIO BERDA (Forskål), 1775.

Tropical Black Bream.

(Plates XVIII, XXII and XXIII.)

Distribution.—In Australia this species is restricted to the tropics of the Northern Territory and North Queensland with a southerly limit of 20° S. latitude on the east coast. This corresponds with the northern half of the Banksian and part of the Damperian Marine Regions (text-fig. 1). Darwin appears to be the extreme western limit on the north coast, and the Burdekin River the southern limit on the east coast. The range overlaps that of *australis* in Northern Queensland and *latus* in the Gulf of Carpentaria and Arnheim Land. The species belongs to the tropical fauna of the Indo-Pacific. It has been recorded from (text-fig. 3) South Africa (eastern), Madagascar, Red Sea, Socotra, Arabia, Baluchistan, India, Ceylon, Andaman Is., Malaya, Indo-China, China, Riu-Kiu Is., Formosa, Philippine Is., Borneo, Sumatra, Java, Celebes, Madura, Bali, Bintang, Soembawa, Saleyer, New Guinea, New Britain, Solomon Is., Australia, New Caledonia, New Hebrides, Society Is. In the Northern Hemisphere it extends further westward than *latus*, but unlike *latus* does not extend beyond China and Riu-Kiu Is. eastward to Japan. The distribution is reversed in the Southern Hemisphere where *latus* occurs only in Western Australia and *berda* only in eastern Australia and Oceania (text-figs. 3 and 4). In Northern Queensland it is known as " Black Bream " on account of its dark colour, or " Pikey Bream " on account of the enlarged second anal spine. Although a good food fish it is not marketed to any extent by commercial fishermen.

Size.—Growth rate unknown. Largest known specimen from the Australian region is from Gulf of Papua which measures 367 millimetres in total length (340 mm. L.C.F.). Day (1875) recorded examples from Sind (India) of 30 inches (760 mm.). Smith (1938) considered 400 millimetres the largest size from South Africa. Fowler (1933) recorded specimens 372 millimetres from " Japan," 413 millimetres from the Philippines.

Colour.—G. Coates has loaned a colour drawing of a Townsville specimen in which the general ground colour is dark grey to black with a tinge of purple. Back dark grey or black, devoid of cross bands or longitudinal streaks in adults ; belly and chin lighter grey, the scales whitish with dusky shading ; head dark dorsally on snout, interorbital and nape ; paler slate grey ventrally and on preoperculum and operculum; lips pale ; iris golden ; spines and rays of dorsal fin light grey, membranes darker grey with black blotching and dark margin ; anal fin spines white with dusky shading, rays grey, membrane dark grey with black shading ; ventral fin spines and rays light grey, membrane medium grey with black shading distally ; pectoral fin medium grey with yellowish tinge ; pectoral axilla with indistinct black spot ; caudal fin medium grey with darker shading. The colouration is darker than in other Australian breams except *palmaris*. After years of preservation, specimens turn dusky purple-brown. Young specimens are olivaceous, and scale rows of checks and back are marked with dusky longitudinal streaks ; distinguished from those of *australis* by darker body colour, lack of vertical cross-banding and dusky colour of ventral and anal fins.

Others have recognised two colour forms. The predominant form of Africa and the Red Sea is paler than that described above. It is recorded also from India, China, Philippines and East Indies. Head and body dark silver-grey or olive dorsally with darker longitudinal streaks along scale rows ; pale to silver ventrally ; snout greenish ; iris silver ; dorsal fin spines silver, membrane grey with dark margin ; caudal fin grey with dark margin ; pectoral fin yellowish ; ventral and anal fins black distally ; dark blotch at origin of lateral line. The darker form of Australia, corresponding to " Calamara " (Russell, 1803) or *hasta* Bloch and Schneider (1801), also occurs throughout the entire range of the species. Dark fish from South Africa are the basis of *robinsoni* Gilchrist and Thompson (1908). Colour variation is probably related to habitat, dark forms being typical of muddy upper reaches of rivers.

FIN FORMULA (Table I).—The modal formula is identical with that of other Australian species of *Mylio*. Last ray in both dorsal and anal fins is small and united to the preceding ray. All counts fall within range of variation exhibited by specimens from other parts of the distribution. Not more than 9 anal rays occur in Australian fishes, whereas 10 have been recorded in some instances from Red Sea, Mozambique, India and East Indies specimens.

Range of variation.—D. (XI–XII) + (10–13) ; A. III + (8–9) ; V. I + 5 ; P. 15–17.

Modal formula.—D. XI + 12 ; A. III + 9 ; V. I + 5 ; P 15.

BODY PROPORTIONS.—Ratios of body parts of specimens from New Guinea and northern Australia are summarised as means and ranges of variation (Table IV.). Similar ratios calculated for a small specimen from Natal (Aust. Mus. IA 6936) are close to the ranges given by Australian material. The pectoral fin is shorter and the eye diameter less (6·7), but Smith (1938) states that the latter ratio in South African specimens is 3·5 to 5·0, which is comparable to the range of Australian fish. Body proportions of Australian specimens compare favourably with those of specimens from other countries. Anterior profile of head usually very high and straight, with slight protuberance at eye (cf. *australis*), slightly concave above eye in old specimens. Head length shorter than in other species of *Mylio* (4·51, other species 3·46 to 4·86). Suborbital variable, narrower than in other species (6·82, other species 5·12), usually equals half eye. Snout slightly shorter than maxilla. Maxilla extends to below middle of eye. Ventral profile of head continued as almost straight line to anus (cf. *australis*). Body height greater than in other Australian breams. Dorsal fin originates directly above or slightly in advance of (rarely behind) posterior border of operculum ; first spine shortest, less than half second spine ; fourth spine usually longest, longer than dorsal rays including basal sheath. Anal fin commences under 2nd or 3rd dorsal ray ; first spine shortest, 4 to 5 in second spine ; second spine longest, extremely stout, longer than anal rays including basal sheath, longer than longest dorsal spine, surface sculptured, longer and stronger than in any other species of *Mylio* ; third spine strong, but weaker and shorter than second. Scaly sheaths of dorsal and anal fins well developed, equal 3 (rarely 4) and 2 respectively in exposed parts of rays. Pectoral fin extends to origin of soft dorsal, relatively longer than in other species of *Mylio* (2·86, other species 3·03 to 3·23). Ventral fins originate posterior to origin of spinous dorsal ; spine longer than in other species ; rays reach almost to anus (three-quarters to seven-eighths of distance). Caudal fin comparable in length to *butcheri*, shorter than in other species ; tips bluntly rounded even in young.

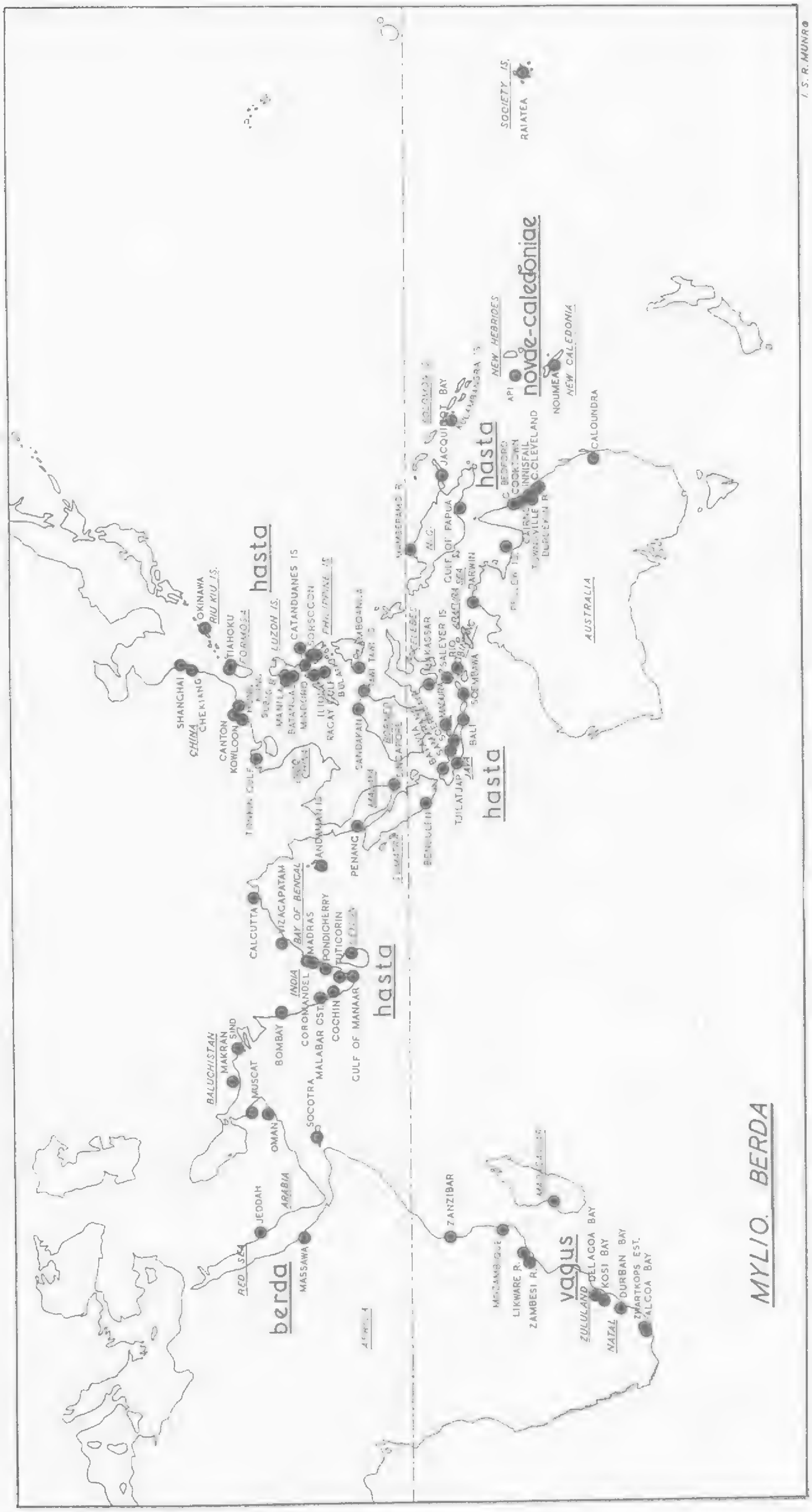


FIG. 3.—World Distribution of *Mylio berda* (Forskål).

SCALES (Table II.).—Lateral line scales, including 4 to 6 on caudal base, vary from 46 to 54, but 88 per cent. of individuals have 48 to 52 and the mean count in 35 fish is 50 (cf. *latus*, *palmaris*). Counts given by other workers are 48 to 51 (Red Sea, Socotra), 43 to 52 (Africa), 35 to 53 (India, China, East Indies) and 47 (New Caledonia), agreeing closely in upper limits with Australian specimens; the lower limits differ probably because the scales on caudal base have not always been included; more accurate descriptions from above localities give 43 to 46 with 4 to 6 more on caudal base, which is in close agreement with Australian counts. A specimen from Natal has 50. Lateral line low, evenly arched, reaching maximum height under 6th or 7th dorsal spine. Australian specimens have 4 scale rows above lateral line, but authors give either 4 or 5 for other localities. Rüppell's (1835) figure depicts 6 to 8 (Red Sea), but Klunzinger (1884) re-examined Rüppell's fish and showed the count to be 4. Day (1875, 1889) stated 6 rows but his accompanying figures show only 4 or 5 (India). Smith (1938) gave the count as 4 (South Africa). The specimen from Natal has 4. Scales below the lateral line in Australian specimens vary from 11 to 12 while 9 to 13 are indicated for Indo-Pacific generally. Klunzinger (1884) has shown that Rüppell's count of 15 should be 10. Australian specimens have 5 or 6 rows on preoperculum; 4 or 5 on operculum.

Scales above lateral line cycloid, more usually weakly ctenoid; ctenoid spines restricted to centre part of exposed margin. Scales below lateral line (Plate XXII, fig. 3) strongly ctenoid; ctenoid margin 0·25 to 0·35 millimetres wide, 5 (rarely 6) series of spines, outermost only with entire points, innermost not clearly separated from central area of scales; anterior margin crenulate with 11 to 17 (usually 12 to 16) radii. Ctenoid spines variable in shape, generally elongate and acutely tapered throughout their length; degenerate spines squat and bulbous. Lateral line scales (Plate XXIII, fig. 3) strongly ctenoid; posterior margin slightly indented; tubule strangulated, narrow, bifurcating posteriorly, each branch terminating in a single pore; normally 2 pores but occasionally 4.

GILL-RAKERS (Table III.).—Dorsal limb of first arch bears 5 to 8, ventral limb 9 to 11 and total count 15 to 18 (commonly 16 or 17). Modal formula in Australian specimens is $6 + 10 = 16$. Few data for other parts of the range are available. Fowler (1925, 1933) gave counts $6 + 10$, $5 + 12$, and Smith (1938) gave $9 + 11$ (South Africa). The example from Natal (IA 6936) has $6 + 8$.

TEETH.—Six curved peg-like incisors in front of both jaws. Molars in 4 or 5 series on each side of upper jaw and in 3 or 4 series on each side of lower jaw; with bluntly rounded crowns; small anteriorly becoming progressively larger posteriorly. Largest molars form third row from periphery in upper jaw and innermost row in lower jaw. Minute molars form a villiform patch behind incisors. Molars of outer series in both jaws slightly flattened, subconical. Pattern typical of *Mylio*. (Text-fig. 2, C and C′). Dentition tritorial.

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Ogilby 1918, p. 105 (Caloundra); McCulloch and Whitley 1925, p. 155; Fowler 1926, p. 775 (Bombay); Herre and Montalban 1927, p. 430, pl. 6 (La Union, Subig Bay, Manila, Pasay, Tawitawi Is., Sorsogan, Sandakan); Paradice and Whitley 1927, p. 88 (Darwin, Sir Edward Pellew Is.); Fowler 1928 A, p. 218 (Noumea, Port-de-France, Uitoe, Katnala); Fowler 1928 B, p. 709 (Ceylon); McCulloch 1929, p. 232; Fowler 1929A, p. 596 (Shanghai); Fowler 1929 B, p. 610 (Hong Kong); 1933, p. 157, fig. 8 (Catanduanes Is., Iliolo, Manila, Mindoro, Ragay Gulf, Zamboanga, Sandakan, Kowloon, Okinawa, Delagoa Bay, Durban Bay); 1934, p. 470 (Durban Bay); Marchand 1935, p. 119, fig. 93 (Natal, Zululand); N. Q'land. Nat. 1935, p. 47 (Cairns); Whitley 1936, p. 24 (Cairns); Herre 1936, p. 202 (Kulambangra Isl); Weber and Beaufort 1936, p. 470, fig. 93; Fowler 1938 A, p. 283 (Raiatea); 1938 B, p. 158 (Penang, Singapore); 1940, p. 58, fig. 50 (Hong Kong, Kowloon, Canton, Shanghai); Herklots and Lin 1940, p. 39, fig. 27; Hardenberg 1941, p. 229 (Mamberamo R.); Herre 1941, p. 365 (Andaman Is.); N. Q'land. Nat. 1945, p. 5. *Non* Risso 1810, p. 252.

Chrysophrys berda Cuvier and Valenciennes 1830, p. 83 *partim* (Pondicherry); Bleeker 1845, p. 522 (Batavia); Richardson 1846, p. 240 (Canton); Peters 1855, p. 242 (Mozambique); Günther 1859, p. 494; Klunzinger 1870, p. 758 (Red Sea); Day 1875, p. 140, pl. 31 (Sind, Madras, Malabar); 1888, p. 788; 1889, p. 44; Thurston 1890, p. 92 (Tuticorin, Gulf of Manaar); Steindachner 1902, p. 135 (Socotra); Zugmayer 1913, p. 11 (Mekran); Pearson 1915, p. 14 (Ceylon).

Chrysophris berda Cuvier 1829, p. 181; Voigt 1832, p. 250; Griffith 1834, p. 163; Rüppell 1835, p. 111, pl. 27 (Djedda).

Aurata berda Cloquet 1818, p. 553.

Pagrus berda Barnard 1927, p. 703 (Natal, Zululand, Delagoa Bay, Zambesi R.).

Acanthopagrus berda Smith 1938, p. 237, fig. 3, pl. 18 (Zwartkops Est., Algoa Bay, Natal); Munro 1945 B, p. 2.

Chrysophrys berda var. *calamara* Day 1875, p. 140, pl. 35 (Madras, Malabar); Borodin 1932, p. 83 (Raiatea).

Sparus hasta Bloch and Schneider 1801, p. 275 (Coromandel–Type Locality); Bleeker 1873, p. 138 (China); 1875, p. 92 (Madagascar); 1876–77, p. 108 (Benculen, Pinang, Singapore, Rio, Batavia, Samarang, Surabaya, Tjilatlap, Madura, Bali, Makassar, Philippine Is.); Macleay 1881, p. 118 (Darwin); Maxwell 1921, p. 95 (Malaya); Oshima 1927, p. 149 (Formosa); Okada 1938, p. 194 (Formosa).

Chrysophrys hasta Günther 1859, p. 490 *partim* (Ceylon, Bengal Bay, Madras); Bleeker 1877, p. 9, pl. 3; Macleay 1878, p. 351 (Darwin); Karoli 1881, p. 157 (Canton); Macleay 1884 A, p. 265 (Gulf of Papua); 1884 B, p. 203 (Burdekin R.,); Boulenger 1887, p. 659 (Muscat); Kent 1889, p. 3 (Queensland); Sauvage 1891, p. 195, pl. 25a (Madagascar); Kent 1893; Casto de Elera 1895, p. 484 (Manila, Navatos); Regan 1908, p. 245 (Kosi Bay); Zugmayer 1913, p. 11 (Mekran, Oman); Gilchrist and Thompson 1917, p. 361; Duncker and Mohr 1931, p. 66 (Jacquinot Bay).

Chrysophris hasta Cuvier 1829, p. 181; Voigt 1832, p. 250; Griffith 1834, p. 163.

Sparus calamara Bleeker 1873, p. 117, 138 (China); Evermann and Seale 1907, p. 86 (Bulan); Seale 1910, p. 277 (Sandakan).

Chrysophrys calamara Cuvier and Valenciennes 1830, p. 85 (Madras–Type Locality; Malabar, Java; based on "Calamara," Russell 1803, p. 73, pl. 92, Vizagapatam); Bleeker 1849, p. 5, 10 (Java, Madura, Soembawa); Cantor 1850, p. 1030 (Pinang Sea); Günther 1859, p. 494; Bleeker 1860 A, p. 236 (Singapore); 1860 B, p. 448; Day 1865 A, p. 30 (Malabar); 1865 B, p. 16 (Cochin); Casto de Elera 1895, p. 484 (Batangas, Manila, Nasugbu); Pellgrin 1906, p. 84 (Tonkin).

Chrysophris calamara Cuvier 1829, p. 181; Voigt 1832, p. 250; Griffith 1834, p. 163; Jouan 1868, p. 261 (Hong Kong).

Chrysophrys vagus Peters 1852, p. 681 (Mozambique–Type Locality) ; 1868, p. 11, pl. 2 ; Martens 1869, p. 141 (Zambesi R., Licuare R.) ; Boulenger 1915, p. 132, fig. 96 ; Thompson 1918, p. 93.

Chrysophrys (Acanthopagrus) vagus Peters 1855, p. 242.

Chrysophrys novae-caledoniae Castelnau 1873 D, p. 110 (Noumea–Type Locality).

Chrysophrys estuarius Gilchrist and Thompson 1908, p. 170 (Natal–Type Locality) ; 1917, p. 361.

Sparus robinsoni Fowler 1925, p. 236 (Delagoa Bay).

Chrysophrys robinsoni Gilchrist and Thompson 1908, p. 170 (Natal–Type Locality) ; 1917, p. 362.

Pagrus caffer Castelnau 1861, p. 30 (Port Natal–Type Locality).

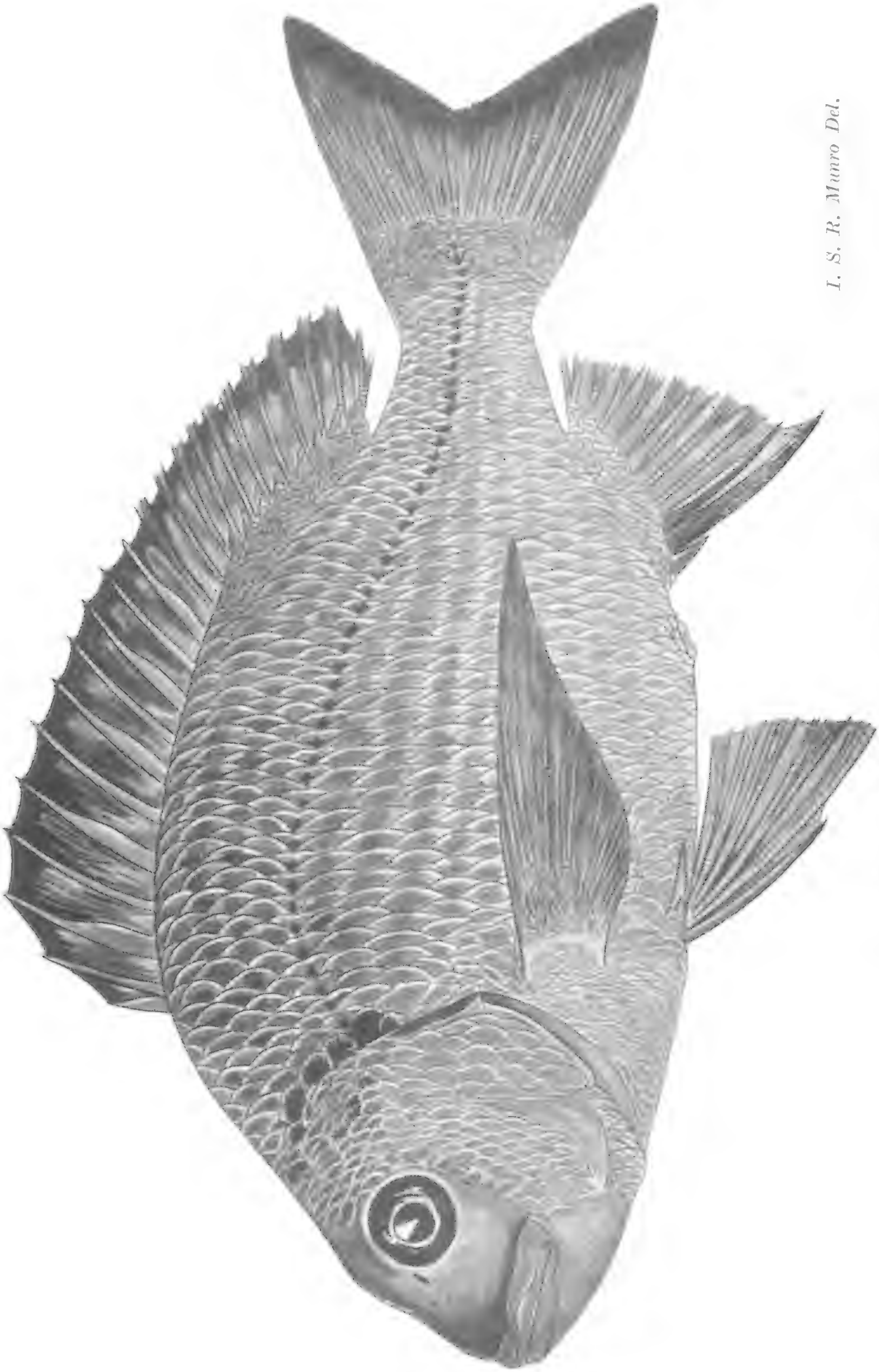
Chrysophrys datnia (*non* Buchanan–Hamilton) Pelligrin 1912, p. 6 (Massawa).

Chrysophrys australis (*non* Günther) De Vis 1883, p. 457 (Api).

Sparus australis (*non* Günther) Fowler 1928A, p. 218 *partim* ; 1944, p. 192.

The dark coloured examples from Australia and New Guinea appear to be identical with *Sparus hasta* Bloch and Schneider (1801) (Type Locality, Coromandel). Day (1875), who examined Bloch's holotype, showed that " Calamara " of Russell (1803) and *Chrysophrys calamara* Cuvier and Valenciennes (1830), also from Coromandel, are synonyms of *hasta.* Authors have doubted whether *hasta* (Indo-Australia) is a synonym of *berda* Forskål (Red Sea). The main reason seems to be a lack of direct comparison between specimens from both localities. Alleged differences concern body height, strength of anal fin and scale counts. The first two characters are variable and the last named is due to inaccuracy in description and illustration on the part of Rüppell (1835). Klunzinger (1884) re-examined Rüppell's dried skins from the Red Sea and found that they possessed fewer scale rows than originally indicated ; he claimed that shape, colouration and scale counts of Red Sea fish were in agreement with accounts of Indian specimens. *Chrysophrys vagus* Peters (1852) from Mozambique, the holotype of which has been illustrated by Boulenger (1915), also appears to be identical. Barnard (1927) and Smith (1938) place *vagus* in the synonym of *berda.* These last named authors have also independently re-examined the types of *Chrysophrys robinsoni* and *C. estuarius* Gilchrist and Thompson (1908) from Natal, and claim both as colour forms of *berda.* Fowler (1933) accepted *Pagrus caffer* Castelnau (1861), also from Natal, as another synonym. *Chrysophrys novae-caledoniae* Castelnau (1873 D) from Noumea appears to be similar to the Australian and New Guinea material examined. Only one extra-Australian specimen (Aust. Mus. IA 6936, Natal) has been examined and it is identical with Australian representatives. Fowler, who has compared specimens from South Africa, China, Riu Kiu Is., Philippine Is. and Borneo (1933), Ceylon (1928 B), Malaya (1938 B), New Caledonia (1928 A) and Society Is. (1938 A), is satisfied to place all together as a single species. As the range is wide for a single species, it is possible that a number of sub-species occur. At present there is no evidence (morphologically) to substantiate such separation but the following names are available, *vagus* (Africa), *berda* (Red Sea), *hasta* (Indo-Australia, China) and *novae-caledoniae* (Oceania) (Text-fig. 3).

MATERIAL.—*Queensland Museum*—I 896 (Innisfail), I 5293 (Cairns), I 5729, 5982 (Cape Cleveland), I 1480–1, 6595 (Townsville). *Australian Museum*—I 5277–8 (Darwin), IA 1479 (Pellew Is.), I 9067, 13427 (Gulf of Papua), I 14001 (Cape Bedford), I 14526 (Walkers Bay, Cooktown), I 18266, 18296 (Burdekin R.). *Other Material*—19 specimens from Townsville (79–281 mm.) (G. Coates).



I. S. R. Munro Del.

PLATE XIX.—Japanese Bream. *Mylio latus* (Houttuyn).

Queensland Museum Reg. No. I 3986, from Sir Edward Pellew Islands. Length, 195 millimetres.

MYLIO LATUS (Houttuyn), 1782.

Japanese Bream.

(Plates XIX, XXII and XXIII.)

Distribution.—In Australia this species is restricted to the tropics of the Northern Territory and north-western Australia, with a southerly limit of 26° S. latitude on the west coast. This corresponds almost exactly with the Dampierian Marine Region (Text-fig. 1). At the western extremity of its range south of Sharks Bay, it is replaced by *butcheri*, and in the east it overlaps *berda* in Arnheim Land and the Gulf of Carpentaria. It is unknown east of Sir Edward Pellew Islands. The species belongs to the tropical fauna of the Indo-Pacific. It has been recorded from (Text-fig. 4) Iran, Baluchistan, India, Burma, Malaya, Thailand, Indo-China, Hainan, China, Korea, Japan, Riu-Kiu Is., Formosa, Philippine Is., Java, Lombok and north-western Australia. The distribution is limited to between the parallels of 26° N. and S. latitude in the Indian Ocean and 43° N. and 16° S. in the Pacific Ocean. It largely overlaps the distribution of *berda* (cf. Text-fig. 3), but unlike that species, it does not extend as far westward as the Red Sea or Africa. On the other hand, it does occur further to the east and is common throughout the Japanese Islands (Hokkaido to Kyushu). The distribution is reversed in the Southern Hemisphere, occurring only west of Carpentaria and is unknown from Queensland or Oceania. The species is little known in Australia and is of no commercial importance at present. It is called " Yellow-fin Bream " by fishermen in Western Australia.

Size.—Growth rate unknown. The largest example from Australia noted by G. P. Whitley at Sharks Bay, measured 360 millimetres (14¼ inches). Day (1889) claimed that the species grows to 18 inches (460 millimetres) in India, and Herre and Montalban (1927) reported that it grows to 500 millimetres in the Philippine Islands.

Colour.—G. P. Whitley recorded the colouration of a fresh specimen from Denham as follows. Head and body pale grey to whitish ; iris light grey to olive-yellowish ; dorsal fins greyish to hyaline ; ventral and anal fins whitish tinged with yellow ; caudal fin bright yellow with black margin. Other examples seen by him (Peron Peninsula) had sub-vertical darker cross-bands on back, which, as in *australis*, fade upon death, and golden streaks along the longitudinal scale rows of back. The latter markings persist as greyish streaks in the preserved specimens from Pellew Islands. These specimens have broad black margins to caudal and spinous dorsal fins ; dusky mottling on dorsal fin membrane ; dusky shading at base of caudal fin ; dark interorbital band. There is no black spot in pectoral axilla, but some faint dusky shading occurs in that position as noted by Tanaka (1914) in Japanese examples. There is a diffuse blotch at origin of lateral line, and a dark edge along the operculum. Colour agrees in most details with those described from other parts of the range. It more closely resembles *australis* than *berda*. The yellow caudal fin is diagnostic.

Fin Formula (Table I).—The number of observations is limited, but the modal formula appears to be identical with that of other Australian species of *Mylio*, and all counts fall within the range of variation exhibited by specimens from other parts of its distribution. Last ray in both dorsal and anal fins is small and united to the preceding ray.

Range of variation.—D. XI + (11–12) ; A. III + (8–9) ; V. I + 5 ; P. 13–15.

Modal formula.—D. XI + 12 ; A. III + 9 ; V. I + 5 ; P. 15.

Body Proportions.—Ratios of 5 Australian specimens are summarised as means and ranges of variation (Table IV). Similar ratios calculated for two Indian specimens from the Australian Museum Collection (B 8280, Calcutta and B 8265, Sind) have values that fall within the range exhibited by the Australian specimens. Slight differences in snout, maxilla and interorbital of Indian specimens can be accounted for by the fact that these specimens are distorted by shrinkage from long preservation. Australian specimens agree with the descriptions of overseas examples ; shape and proportions are closely similar to those indicated in figures of the same species from India (Buchanan-Hamilton 1822), Japan (Temminck and Schlegel 1843, Tanaka 1914), East Indies (Bleeker 1876-77) and Philippine Islands (Herre and Montalban 1927). Anterior profile of head notably convex and angular due to prominent bulge at eye (greater than in *australis* or *berda*). Older fishes have in addition a shallow concavity above eye. Suborbital variable, sometimes greater, sometimes less than eye. Snout equal to or slightly less than maxilla. Maxilla extends to below middle of eye. Ventral profile of head continued as almost a straight line to anus. Body height less than in *berda*, greater than in other Australian species. Dorsal fin originates directly above or slightly in advance of opercular margin ; first spine shortest, equal to about half second spine ; fourth spine longest, longer than dorsal rays including basal sheath. Anal fin commences under 2nd dorsal ray ; first spine equals 5 in second spine ; second spine longest, weak, slightly sculptured, exceeds length of dorsal spines and anal rays including basal sheath, comparable in length and strength to *butcheri* ; third spine shorter than second, of equal strength. Scaly sheaths of dorsal and anal fins of medium development, equal 4 and 3 respectively in lengths of exposed rays. Pectoral fin extends further back than in other species, reaching 3rd anal ray. Ventral fins also longer, reaching to anus. Caudal fin tips sharp.

Scales (Table II).—Lateral line scales, including those on caudal base, vary from 48 to 52 with a mean count of 50 (cf. *palmaris, berda*). Counts in specimens from Calcutta and Sind are respectively 51 and 50. Other workers give 42 to 48, but many omit the scales on caudal base ; Fowler (1933, 1940) gave 41 to 48 with additional 6 to 11 on caudal base. Lateral line evenly arched, reaching maximum height under 3rd or 4th dorsal spine. Scale rows above lateral line are 4 (4 specimens) or 5 (2 specimens) in Australian examples ; similarly 4 (Sind) or 5 (Calcutta) in Indian specimens. Most authors give 4 or 5. Higher counts (6 to 8) given by Fowler (1928 C, 1933, 1940) presumably refer to predorsal region. Tanaka (1914) indicated 7 in text, 4 in figure (Japan). Scale rows below lateral line vary from 11 to 14 (50 per cent. with 13) in Australian material. Others give 9 to 14. The original figure of *datnia* Buchanan-Hamilton (1822) from Ganges has 13 rows. Preoperculum of Australian examples with 6 rows (5 specimens, 4 in one other). Operculum with 5 rows. Indian specimens have 6 and 5 rows respectively.

Scales above lateral line variable, cycloid (Pellew Is., Sharks Bay), reduced ctenoid (Pellew Is.) or strongly ctenoid (Onslow). The two Indian examples show similar variation. Scales below lateral line (Plate XXII, fig. 4) strongly ctenoid in all cases ; ctenoid margin 0·25 to 0·30 millimetres wide, 4 (rarely 3 or 5) series of spines, outermost only with entire points, innermost not clearly separated from central area

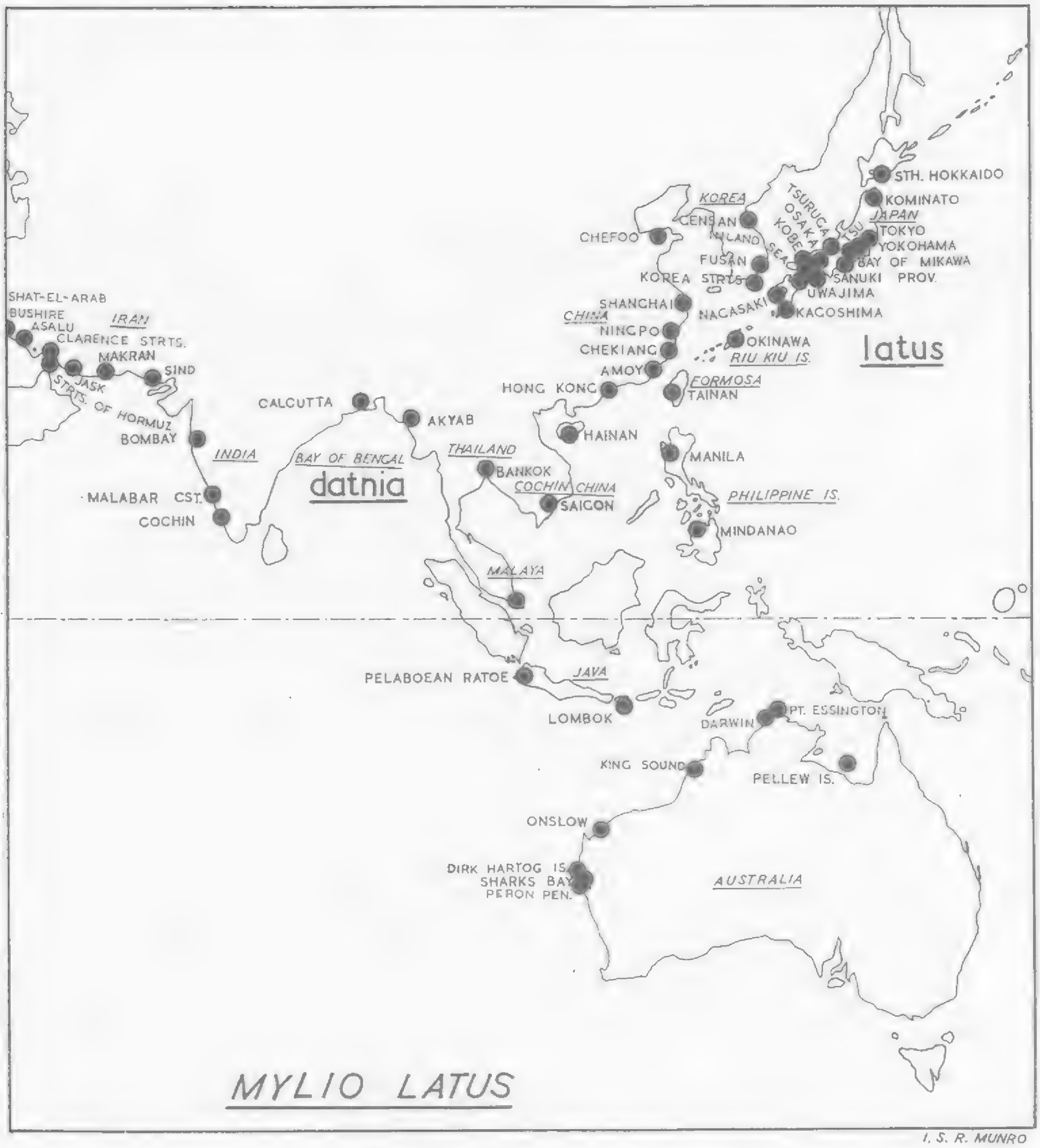


FIG. 4.—World Distribution of *Mylio latus* (Houttuyn).

of scale; anterior margin crenulate with 11 to 15 radii (18, Sharks Bay) (11 to 13, India). Lateral line scales (Plate XXIII, fig. 4) strongly ctenoid; posterior margin indented; tubule strangulated, narrow, bifurcating posteriorly, each branch terminating in a single pore; normally 2 pores to each scale.

Gill-rakers (Table III).—Dorsal limb of first arch bears 5 to 7, ventral limb 8 to 10 (usually 9) and total count usually 14 (15 and 17, Pellew Is.). Modal formula in Australian specimens is $5 + 9 = 14$. Other counts are 4 to 7 on dorsal limb, 8 to 11 on ventral limb (India to Japan), agreeing with Australian counts. Indian specimens have $8 + 10$ (Calcutta) and $7 + 9$ (Sind).

Teeth.—Six curved peg-like incisors in front of both jaws. Molars in 4 or 5 series on each side of upper jaw, and in 3 or 4 series on each side of lower jaw; with bluntly rounded crowns; small anteriorly becoming progressively larger posteriorly. Largest molars form third row from periphery in upper jaw and innermost row in lower jaw. Minute molars form a villiform patch behind incisors. Molars of outer series in both jaws slightly flattened, subconical. Pattern typical of *Mylio*, identical with that in *australis*, *berda* and *butcheri*. Dentition tritorial.

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Coius datnia Buchanan–Hamilton 1822, p. 369, pl. 9 (Ganges Delta–Type Locality).

Sparus datnia Bleeker 1876–77, p. 109, pl. 361 (77) (? Java, Manila); 1877, p. 5, pl. 2 (Nagasaki, Calcutta); 1879 B, p. 8 (Nagasaki); Bean and Weed 1912, p. 606 (Pelaboean Ratoe); Weber 1913, p. 292 (Lombok); Seale 1914, p. 67 (Hong Kong); Maxwell 1921, p. 95 (Malaya); Herre and Montalban 1927, p. 431, pl. 6 (Paraoir, Manila, Hong Kong, Amoy); Fowler 1928 C, p. 114 (Bombay); ? McCulloch 1929, p. 232 (Australia); Blegvad and Loppenthin 1944, p. 139, fig. 77, pl. 8 (Bushire, Shatt-el-Arab, Asulu, Clarence Strts., Hormuz Strts., Jask).

Sparus (Chrysophrys) datnia Steindachner 1896, p. 201 (Ningpo, Manila, Nagasaki, Tokyo, India).

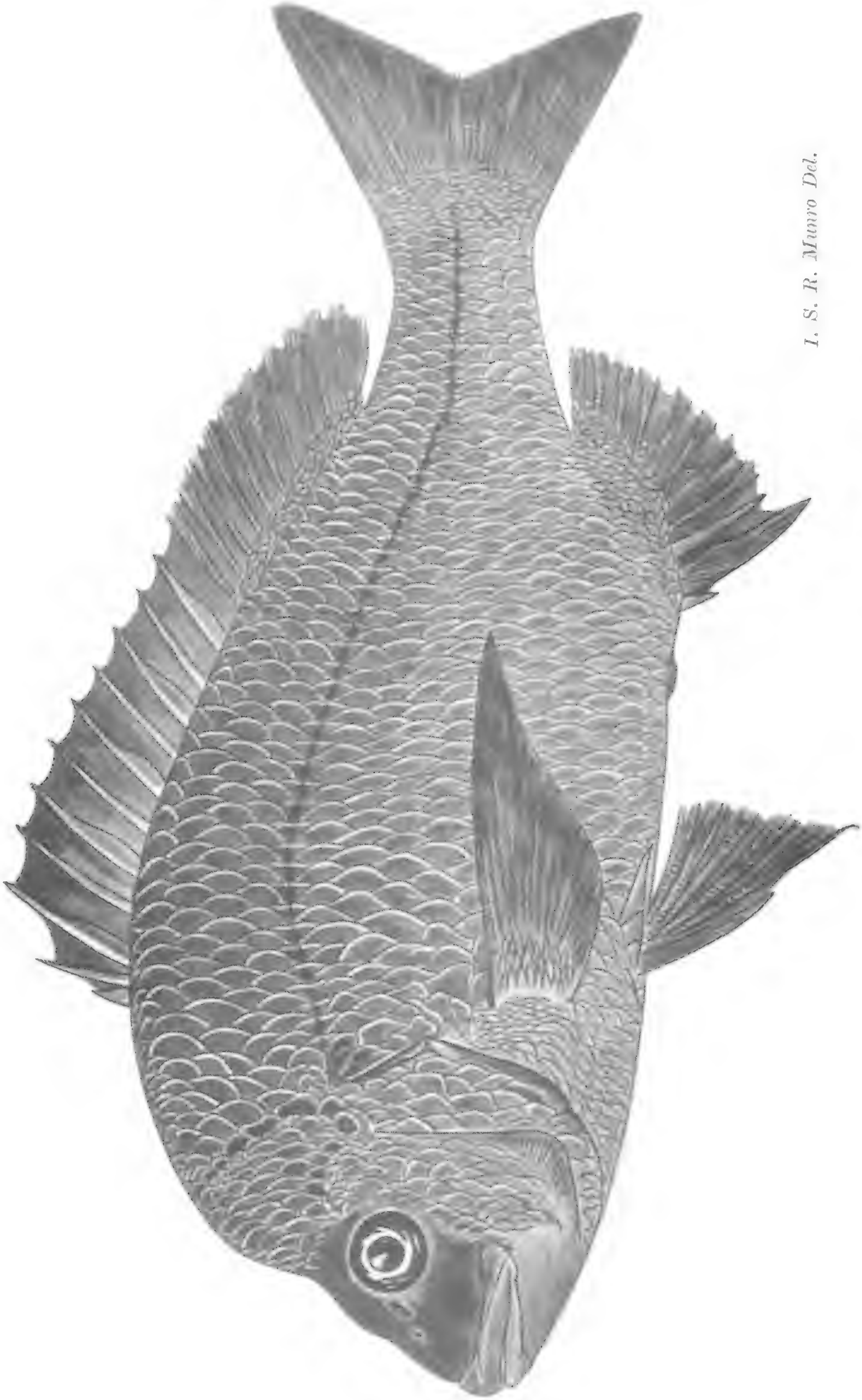
Chrysophrys datnia Day 1875, p. 140, pl. 34 (Calcutta); 1888, p. 788; 1889, p. 14, fig. 17 (Malaya, India); Lloyd 1907, p. 228 (Akyab); Zugmayer 1913, p. 11 (Mekran); Tirant 1929, p. 168 (Cochin China).

Chrysophrys longispinis Cuvier and Valenciennes 1830, p. 116 (Bengal–Type Locality, Japan); Temminck and Schlegel 1843, p. 68, pl. 32 (Japan).

Sparus chrysopterus Kishinouye 1907, p. 327 (Kiusiu, Shikoku, Inland Sea, Hondo–Type Locality).

Sparus schlegeli (*non* Bleeker) Jordan and Snyder 1901 A, p. 355 (Tokyo); 1901 B, p. 80 (Yokohama, Nagasaki).

Sparus hasta (*non* Bloch and Schneider) Tanaka 1933, p. 1100, fig. (Japan).



I. S. R. Munro Del.

PLATE XX.—Hump-Headed Black Bream. *Mylio palmaris* (Whitley).
Australian Museum Reg. No. IB 1562, from Onslow. Length, 306 millimetres.

Chrysophrys hasta (*non* Bloch and Schneider) Günther 1859, p. 490 *partim* (Calcutta, China, Japan, ? Australia); Kner 1865, p. 888 (Java, Manila); Day 1865 A, p. 29 (Malabar); 1865 B, p. 16 (Cochin); Schmeltz 1869, 1874 (Korea Strts.); Martens 1876, p. 388 (Yokohama); Steindachner and Döderlein 1884, p. 17 (Tokyo); Nyström 1887, p. 13 (Nagasaki); Ishikawa and Matsuura 1897, p. 53 (Tokyo).

Sparus berda (*non* Forskål) Paradice and Whitley 1927, p. 88 *partim* (Sir Edward Pellew Is.); Weber and Beaufort 1936, p. 470 *partim.*

Chrysophrys australis ? Günther 1859, p. 494 *partim* (Pt. Essington); Rendahl 1922, p. 165, 190 (Pt. Darwin).

McCulloch (1929) included *datnia*, a synonym of *latus*, in the Australian Check-List. It is possible that this was due to Ogilby (1898), who used the name in error for *sarba*. Probably Günther's (1859) example of *hasta* from North-Western Australia, his example of *australis* from Pt. Essington, and Rendahl's record of *australis* from Darwin, refer to *latus*. Two specimens from Sir Edward Pellew Is. now in the Queensland and the Australian Museums, reported by Paradice and Whitley (1927) as *berda*, belong to *latus*. Jordan and Thompson (1912) have demonstrated that *Coius datnia* Buchanan-Hamilton (1822) from the Ganges is a synonym. Houttuyn's mention of olive spots along the scale rows (absent in *macrocephalus* Basilewski) and 8 anal rays (*sarba*, 11) are sufficient to identify *latus* among Japanese breams. Some authors have confused *latus* with *berda ;* Gunther (1859) recognised only one species (*hasta*), and Weber and Beaufort (1936) who re-examined Bleeker's specimens in the Leiden Museum, recognised only one species (*berda*). However, Bleeker (1876–77, 1877) and Day (1875, 1889) recognised the two species. The synonymy of *latus* has been confused with that of *macrocephalus ;* possibly some of the references listed under the latter by Fowler (1933) refer to *latus*. The excellent descriptions and figures of Bleeker (1877) and Tanaka (1914) show the differences between *latus* and *macrocephalus* (*swinhonsis, schlegeli*). *Chrysophrys longispinis* Cuvier and Valenciennes (1830), figured by Temminck and Schlegel (1843), is a synonym of *latus*. The nominal Chinese species *auripes* and *xanthopoda* Richardson (1846) are claimed to be synonyms. *Sparus chrysopterus* Kishinouye (1907), whose description was translated by Jordan and Thompson (1912) is also identical. Pelegrin's (1912) record of *datnia* from the Red Sea is more likely to be *berda ; latus* is not otherwise known west of the Iranian Gulf.

MATERIAL.—*Queensland Museum*—I 3986 (Sir Edward Pellew Is.), illustrated (Plate IV). *Australian Museum*—IA 1631 (Sir Edward Pellew Is.), IB 1579 (Onslow), I 13156, IB 1563 (Sharks Bay). *Other material*—Notes by G. P. Whitley, an observer on C.S.I.R. research vessel "Isobel," on specimens from Sharks Bay, Gregory, Denham, Peron Peninsula, Dirk Hartog Is., Onslow, Sunday Is. (King Sound).

MYLIO PALMARIS (Whitley), 1935.

Hump-headed Black Bream.

(Plates XX, XXII and XXIII.)

DISTRIBUTION.—Endemic to Australia and restricted to the north-west coast of Western Australia; so far as known occurring only between Exmouth Gulf and Port Hedland.[4] Limited to portion of Dampierian Marine Region, overlapping in part the range of *latus*. The restricted distribution is difficult to interpret. Although

[4] Distribution may be extended to Roebuck Bay if Rendahl's (1922) record of *hasta* refers to *palmaris*.

apparently a valid species, it has affinities with *berda* of tropical Queensland. (Text-fig. 1). Local inhabitants call it " Snapper " because of the resemblance in head shape to large specimens of *Chrysophrys auratus*. It is of no special economic importance, but it is a good food fish.

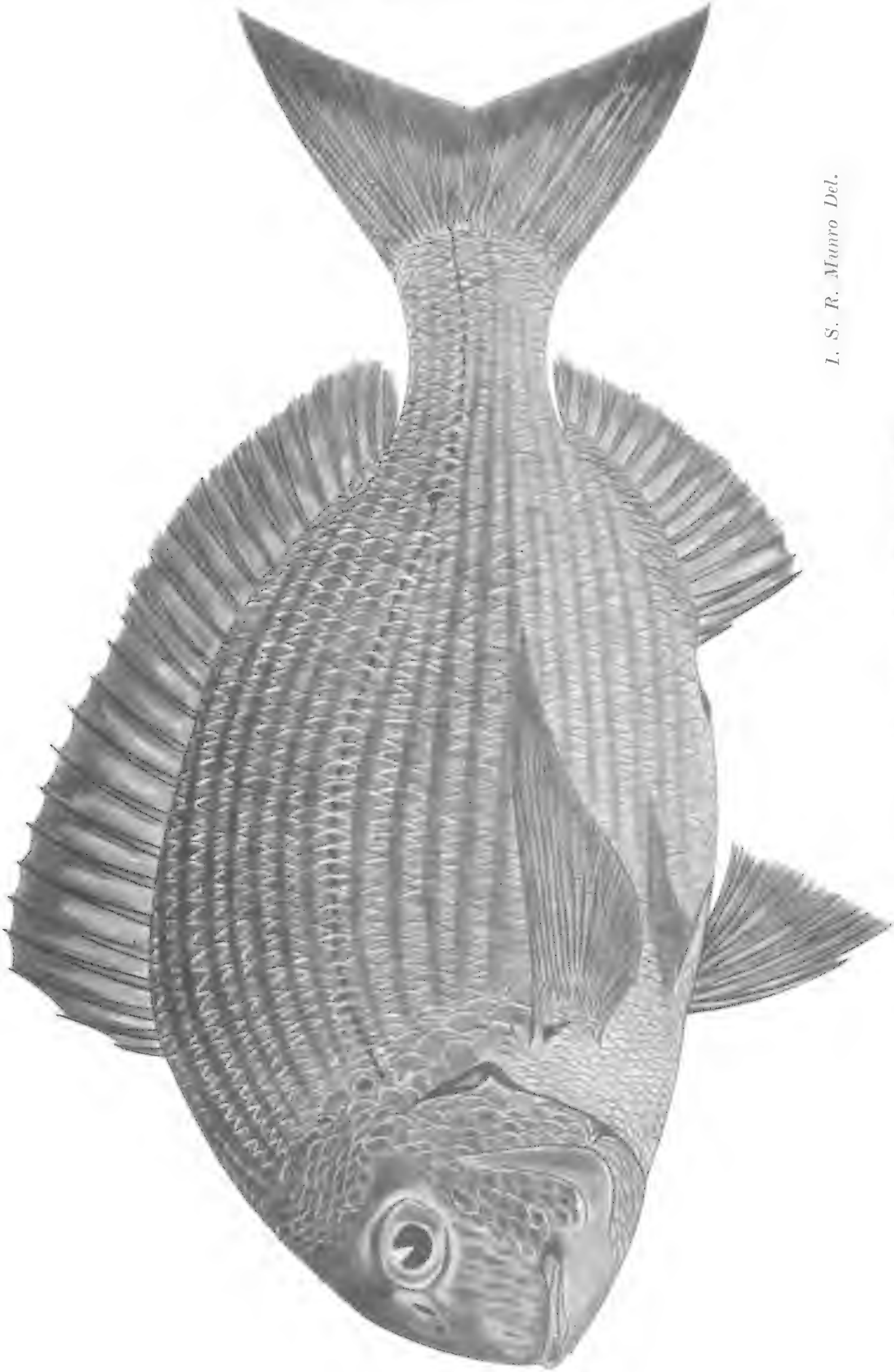
SIZE.—Only four specimens have been examined, the largest measuring 278 millimetres to caudal fork. Growth rate unknown. Older fishes differ from the young in head shape. Smaller specimens have evenly convex anterior head profiles and older ones have a well-defined hump above the eyes. Change in head shape, correlated with increase in age, is analagous to that in the " Red Bream " and " Snapper " stages of *Chrysophrys auratus*.

COLOUR.—In living specimens seen by G. P. Whitley (Onslow) head and body are dark slate grey and fins grey. Old spirit specimens are uniformly brown and lack horizontal streaks or vertical cross-bands. Old preserved specimens (including holotype) have fins uniformly dark, while more recently collected examples have fins lighter ; pectorals, ventrals and anal light but not yellowish, caudal fin with narrow black edge. Judging from all preserved specimens, snout and interorbital are darker than rest of body. Small indistinct dark blotch present behind maxilla ; large diffuse black area at origin of lateral line ; no black spot in pectoral axilla ; dark margin to fleshy posterior border of operculum. Under surface of pectoral fin dusky.

FIN FORMULA (Table I.)—Counts agree closely in all specimens. Modal formula.—D. XI + 12 ; A. III + 9 ; V. I + 5 ; P. 15.

Last ray of both dorsal and anal fins is small and adherent to the preceding ray. The holotype (Australian Museum I 12965) possesses 10 + i instead of 11 + i dorsal rays and the number of dorsal spines is 11, not 12 as stated by Whitley (1935).

BODY PROPORTIONS.—Ratios of the four available specimens are summarised as means and ranges of variation (Table IV). Shape of head profile in older specimens is diagnostic. Anterior head profile is steep, straight along snout, prominently gibbous at eye, extremely tumid at nape between first row of body scales and dorsal fin. This prominent hump is not developed in smaller fishes which have an evenly convex profile. Lips extremely large and fleshy. Suborbital slightly less than eye diameter. Snout equal to or slightly shorter than maxilla. Maxilla extends to beyond middle of eye, usually to below posterior margin of pupil. Ventral profile of head continued as almost a straight line to anus. Body width greater than in other breams of this genus (5·9, cf. 6·4 to 7·9 in others). Body height less than in *berda*. Dorsal fin originates behind posterior margin of operculum ; first spine shortest, equal to half second spine ; fourth spine longest, exceeding dorsal rays including basal sheath. Anal fin commences under 2nd or 3rd dorsal ray ; first spine shortest, equals 5 in second spine ; second spine longest, equivalent in strength to *australis*, surface sculptured, longer than dorsal spines and rays and anal rays including basal sheath ; third spine shorter and much weaker than second. Scale sheaths of dorsal and anal fins equal 4 and 2 respectively in exposed portions of rays. Anal sheath wider than dorsal sheath. Pectoral fins variable in length, not reaching beyond 2nd anal spine. Ventral fins inserted below 3rd dorsal spine and extend only three-quarters distance to anus. Caudal tips not sharp but not as rounded as in *berda*.



I. S. R. Munro Del.

PLATE XXI.—Tarwhine. *Rhabdosargus sarba* (Forskål).

Specimen from Newcastle Fish Market. Length, 256 millimetres.

SCALES (Table II).—Lateral line scales, including 4 to 6 on caudal base, vary from 50 to 52. Whitley (1935) gave this count as 46 in holotype, but he does not include those on the caudal base. Lateral line is evenly arched and reaches maximum height under 4th to 6th dorsal spines. In all specimens 4 rows above lateral line; 11 to 13 below lateral line. Holotype has 11 rows below lateral line, not 10 as stated by Whitley (1935). Between angle of operculum and insertion of ventral fins are 15 to 17 oblique rows. Preoperculum, 5 to 6 rows; operculum, 4 to 5 rows.

Scales above lateral line weakly ctenoid. Scales below lateral line (Plate XXII, fig. 5) strongly ctenoid; ctenoid margin 0·2 to 0·3 millimetres wide, 5 or 6 series of spines, outermost only with entire points; anterior margin crenulate with 11 to 16 (more in older specimens) radii. Lateral line scales (Plate XXIII, fig. 5) strongly ctenoid; posterior margin indented; tubule strangulated, narrow, bifurcating posteriorly, each branch terminating in a single pore; 2 pores to each scale.

GILL-RAKERS (Table III).—Dorsal limb of first arch bears 6 or 7, ventral limb 8 or 9, total count 14 to 16. Modal formula is $6 + 9 = 15$ (cf. *latus*). Dorsal limb has one less raker than in *australis* or *butcheri*. Ventral limb has one less raker than *berda*.

TEETH.—Six curved peg-like incisors in front of both jaws. Molars in 4 or 5 (3 in type, *fide* Whitley 1935) series on each side of upper jaw, and in 2 or 3 series on each side of lower jaw, with bluntly rounded crowns; small anteriorly, becoming progressively larger posteriorly. Molars in outer series in both jaws slightly flattened laterally, subconical. Pattern essentially that of *Mylio* but differs by reduction in number of molar rows in lower jaw (text-fig. 2, E and E′). As it has been impossible to open the mouth of the holotype, dentary characters have been obtained from a younger example (W. Australian Museum, P. 2778). Dentition tritorial.

REFERENCES TO SPECIES IN LITERATURE.

Roughleyia palmaris Whitley 1935, p. 234, fig. 7 (Port Hedland–Type Locality).

Chrysophrys hasta (*non* Bloch and Schneider) Rendahl 1922, p. 164, 190 (Roebuck Bay).

Only four specimens have been preserved in the museums of Australia. On the basis of locality it is very probable that Rendahl's (1922) example of *hasta* from Roebuck Bay refers to *palmaris* rather than *berda*. Otherwise this species has not been noted since its description. Although older specimens resemble *berda* in colour and head shape, the young differ considerably. Dentition alone is sufficient to separate *palmaris* from other species of *Mylio*, but insufficient to exclude it from the same genus.

MATERIAL.—*Australian Museum*—Holotype I 12965 (270 mm.) (Port Hedland), IB 1562 (278 mm.) (Onslow) (Plate V). *Western Australian Museum*—P 2778 (210 mm.) (Exmouth Gulf), P 2843 (218 mm.) (Onslow).

RHABDOSARGUS SARBA (Forskål), 1775.

Tarwhine.

(Plates XXI, XXII and XXIII.)

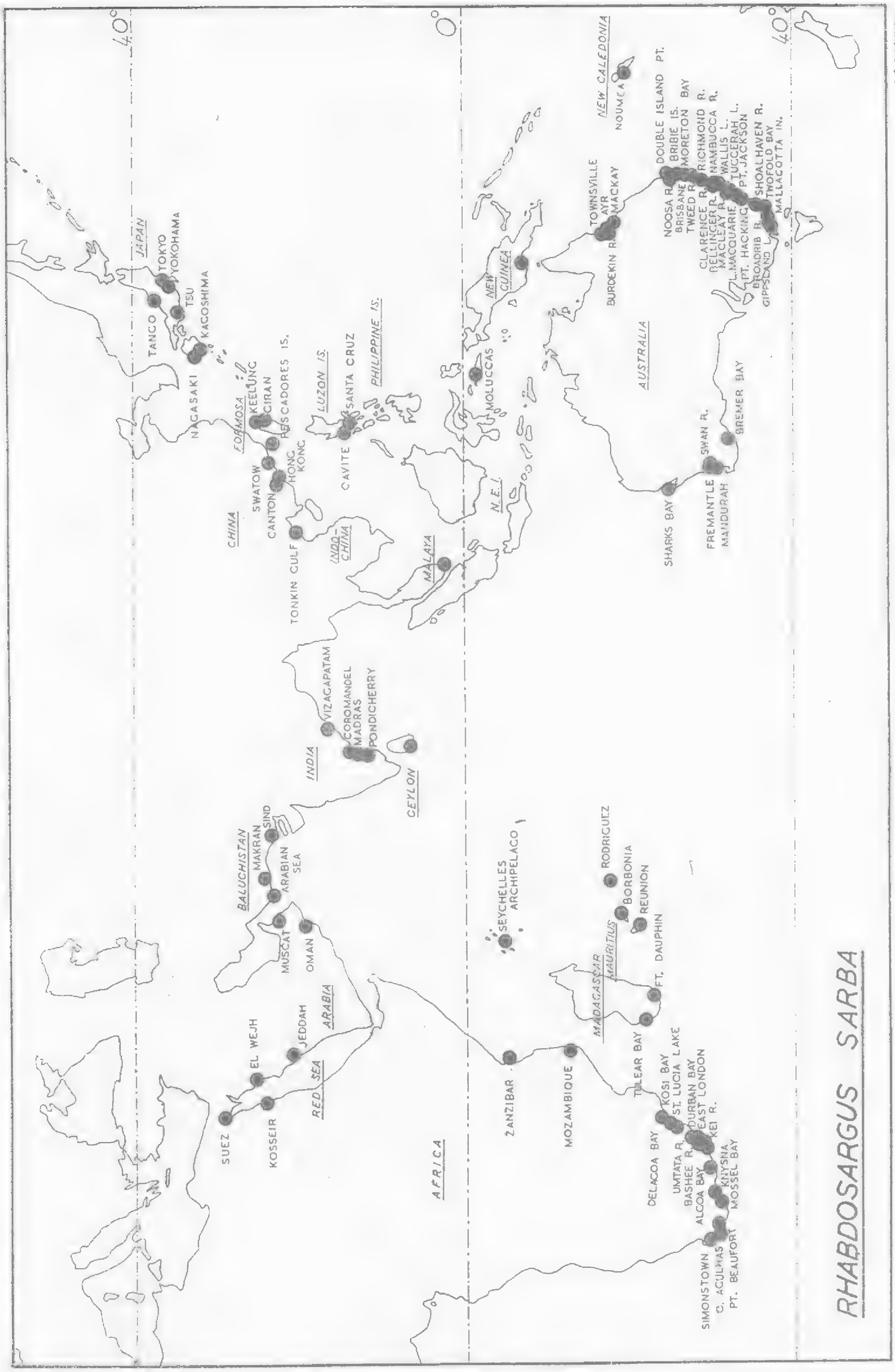
DISTRIBUTION.—In Australia this species is restricted to the east and west coasts, including the States of Queensland, New South Wales, eastern Victoria and Western Australia. This corresponds with the Banksian and Dampierian Marine Regions, extending into the temperate waters of the Peronian and Flindersian Regions. On the east coast it extends as far south as eastern Victoria to Mallacoota Inlet, and

rarely to Gippsland Lakes and Broadrib River (Mack, 1935) ; it is not plentiful south of Shoalhaven River and of little commercial value south of the Hunter River. On the west coast it occurs in commercial quantities south only to Fremantle, but the Western Australian Museum has a specimen from as far south as Bremer Bay. The species belongs to the tropical fauna of the Indo-Pacific (Text-fig. 5) between parallels 40° N. and S. latitude. It has been recorded from South Africa (eastern), Madagascar, Mauritius, Reunion, Rodriguez, Seychelles, Red Sea, Arabia, Baluchistan, India, Ceylon, Malaya, Indo-China, China, Japan, Formosa, Pescadores Is., Philippine Is., Molucca Is., New Guinea, Australia and New Caledonia. Essentially estuarine in habit, young stages occur in coastal lakes, bays, rivers and creeks where marine to brackish conditions exist. At certain times they travel in schools (larger fishes) along ocean beaches. It has been trawled in 33 fathoms off Double Island Point by F.I.S. " Endeavour " (Ogilby, 1915). In eastern States it is called the " Tarwhine " ; in Western Australia " Silver Bream." It is of secondary economic importance. The commercial catch in New South Wales for 1940–1942, mostly from the Hunter River district, averages 57,000 pounds per annum.

Size.—Growth rate unknown. Some Australian specimens attain great size. The largest examined were specimens in the Australian Museum, I 15267 (Macleay River) and I 849 (Lake Macquarie), each measure 425 millimetres in total length (402 millimetres to caudal fork) and weigh 3½ pounds. Russell (1803) claimed that in India examples grow to 16 inches (400 millimetres). Barnard (1927) and Marchand (1935) recorded the largest size from South Africa as 18 inches (460 millimetres), while Smith (1938) gave 600 millimetres as the upper limit. Günther (1859) recorded a specimen of 21 inches (530 millimetres).

Colour.—Head and back silver grey (fresh) or olivaceous (preserved), without vertical cross-banding. Longitudinal scale rows on back and sides with shining golden streaks ; 7 arched above lateral line ; 10 below lateral line, straight and becoming fainter ventrally. Head with gold-bronze reflections on snout, interorbital and around eye. Iris golden brown. Preopercle and opercle silvery with gold spots on scales. Chin and belly silvery white. Lips silver. Dorsal fin spines silvery ; rays hyaline ; membrane hyaline with dusky grey-olivaceous patches and black margin. Spines, rays and membranes of ventral and anal fins orange yellow. Pectoral fins olive-grey, silver to dusky basally. Caudal fin greyish or yellowish, edged with black. Yellow streak on belly, originating at ventrals and extending obliquely upward and backward. No black spot in pectoral axilla. No dusky blotch at origin of lateral line. In some a dark mark on opercle. Colours in general agree with those described from South Africa (Smith 1938), Red Sea (Rüppell 1835) and India (Russell 1803, Day 1875), but Japanese fish differ in having dusky anal and ventral fins (Temminck and Schlegel 1843, Tanaka 1932). *C. haffara* (*non* Forskål, Day 1875) (India) also has dusky fins.

Fin Formula (Table I).—Examples from east and west coasts possess similar counts. As in *Mylio*, last rays of dorsal and anal fins are small and attached to preceding rays. Dorsal rays number 12 + i or 13 + i, counted as 13 or 14 ; anal rays 10 + i or 11 + i, counted as 11 or 12. These counts distinguish *sarba* from the five Australian species of *Mylio*. Counts in all specimens agree with those described from other parts of the species range.



TEXT-FIG. 5.—World Distribution of *Rhabdosargus sarba* (Forskål).

Range of variation.—D. XI + (13–15); A. III + (10–12); V. I + 5; P. 13–15.

Modal formula.—D. XI + 14; A. III + 12; V. I + 5; P. 15.

BODY PROPORTIONS.—Ratios of a combined sample from eastern and western Australia are summarised as means and ranges of variation (Table IV). Data from both coasts, treated separately, agree closely in means, maxima and minima for each ratio. Body proportions of Australian specimens compare favourably with those of specimens from other countries. A single specimen from Mauritius (Australian Museum B 3993) has ratios which fall within the respective ranges exhibited by Australian Tarwhine. Illustrations of examples from India, Red Sea, South Africa, Japan exhibit some differences in shape, but each can be identified with individuals of *sarba* from Australia. Anterior profile of head broadly convex, usually arched evenly between snout tip and dorsal origin. Eye region slightly gibbous. Profile of snout usually straight and almost vertical. Young have head angular, instead of evenly rounded. Although head shape is extremely variable, the general broad convexity distinguishes *sarba* from other Australian breams. Suborbital varie with age; in young slightly less than eye; in large fishes equals or greatly exceeds eye. Snout greater than maxilla. Maxilla extends to below anterior border of pupil, rarely to below middle of eye. Body height not much greater than in *Mylio* but the head is relatively shorter. Dorsal fin originates well behind posterior border of operculum; first spine shortest, equal to 2 in second spine and 3 in third spine; fourth to six spines longest, longer than dorsal rays. Dorsal spines are comparable in strength, and are not alternately narrow and wide, when viewed from one side, as in *Mylio*. Anal fin commences below second or third dorsal ray; first spine shortest, equals 3 or 4 in second spine; second and third spines commonly equal in length and strength, but third may be slightly longer than second; longest spine equal to or slightly longer than anal rays, equal to dorsal rays, shorter than dorsal spines. Anal scale sheath absent; dorsal sheath reduced and structure distinct from *Mylio*, consisting of reduced upper 2 or 3 rows of body scales. Pectoral fins reach to origin of soft anal. Ventrals orginate behind origin of dorsal; usually extend to anus in young, seldom more than three-quarters of this distance in larger fishes. Caudal fin broader than long; emergination shallow; lobes sharply pointed.

SCALES (Table II).—Lateral line scales, including 5 or 6 on caudal base, vary from 55 to 70, majority (74 per cent.) with 62 to 65, and mean count of 63. Samples from east and west Australian coasts exhibit similar modes and ranges of variation. Descriptions from other countries give 50 to 70, most omitting scales on caudal base; 55 to 65 covers range given by authors and agrees with observed range of Australian material. The Mauritius specimen has 62. Lateral line low, gently arched. Usually 7 scale rows above lateral line (few with 8, none with 6), agreeing with the count given for other parts of the range. Scale rows below lateral line vary from 12 to 16, but usually (69 per cent.) 14. Other workers give 12 to 15 in extra-Australian specimens, which agrees with the range of Australian samples (east and west). Preopercle with 5 rows (some with 4, few with 6). Operculum usually with 4 rows.

Scales above lateral line cycloid with broadly rounded posterior border. Scales below lateral line (Plate XXII, fig. 6) weakly ctenoid; ctenoid area reduced to triangular patch; ctenoid margin 0·28 to 0·36 millimetres wide, tapering laterally, 3 to 6 series of spines, outermost 2 or 3 series with entire points; anterior margin

crenulate with 12 to 15 radii. Ctenoid spines squat, triangular, swollen basally. Lateral line scales (Plate XXIII, fig. 6) cycloid; posterior margin broadly rounded, not indented; tubule short, broad, bifurcating posteriorly, each branch composed of linear series of 3 or 4 pores forming a pattern very distinct from that of *Mylio*.

GILL-RAKERS (Table III).—Rakers very short. Dorsal limb of first arch bears 5 to 7, ventral limb 6 to 10, total count 13 to 16. Modal formula $6 + 8 = 14$. Counts agree with those of Japanese specimens (Jordan and Thompson, 1912). South African specimens have $7 + (8–10)$, agreeing with range in Australian material. Samples from east and west Australian coasts exhibit similar ranges of variation for part and whole counts. The count is lower than in *Mylio*.

TEETH.—Six flattened, chisel-shaped incisors in front of both upper and lower jaws; flattened antero-posteriorly, edge triangular when viewed from in front. Molars in 5 regular series on each side of upper jaw, and in 3 or 4 irregular series on each side of lower jaw; all series bluntly rounded; increase in size gradually from front to back in each jaw; ovoid or irregular in horizontal section; one greatly enlarged molar at rear of each jaw. Teeth of *sarba* (Text-fig. 2 G and G′) form a complete pavement to mouth. Dentition tritorial. Pattern differs from that of *Mylio* and is closer to *Sparus* (cf. Mediterranean *S. aurata*, Text-fig. 2 H and H′), having enlarged posterior molar, but differs in having flattened incisiform instead of conic caniniform front teeth.

REFERENCES TO SPECIES IN LITERATURE.

Sparus sarba Forskål 1775, p. 31 (Djedda, Suez–Type Locality); Gmelin 1789, p. 1275; Walbaum 1792, p. 294; Bloch and Schneider 1801, p. 280; Lacépède 1802, p. 30, 97, 103; Cuvier 1816, p. 272; Bleeker 1875, p. 92 (Borbonia, Seychelles); 1876–77, p. 107 (Molucca Archip., on Cuvier and Valenciennes' interpretation of de Vlamingh MS drawing); 1879 A, p. 12 (Mauritius); Kishinouye 1907, p. 329 (Japan); Jordan and Seale 1907, p. 10 (Hong Kong); McCulloch 1912, p. 89 (Fremantle); Ogilby 1915 (Double Island Pt.); Roughley 1916, p. 137; Jordan and Starks 1917, p. 451 (Ceylon, China, Queensland); Ogilby 1918, p. 105 (Queensland); Maxwell 1921, p. 36 (Malaya); McCulloch 1922, p. 88; McCulloch and Whitley 1925, p. 155; Barnard 1927, p. 687 (Algoa Bay, East London, Delagoa Bay); Phillipps 1927, p. 130 (N.S.W.); McCulloch 1929, p. 231; Fowler 1933, p. 149 (N.S.W., Shimizu, Tokyo, Wakanoura, Misaki, Durban Bay, Natal, Delagoa Bay); McCulloch and Whitley 1934, p. 61; Mack 1935, p. 10 (Broadrib R.); Marchand 1935, p. 110 *partim*, fig. 84 (Agulhas Bank, Algoa Bay, East London, Natal, Zululand, Delagoa Bay); Weber and Beaufort 1936, p. 468 (Molucca Is.); Fowler 1940, p. 56, fig. 49 (Hong Kong, East Africa, Natal, Japan, N.S.W.).

Sparus (*Chrysophrys*) *sarba* Klunzinger 1884, p. 43 (Koseir, El Wejh).

Chrysophrys sarba Cuvier and Valenciennes 1830, p. 75, 102 (Mauritius, Madagascar, Djedda, Suez, Coromandel, Pondicherry); Bleeker 1849, p. 4, 5, 6 (Molucca Is., Mauritius, Red Sea, Hindostan); Günther 1859, p. 488; Guichenot 1862, p. 25 (Reunion); Day 1865 B, p. 16 (Madras); Kner 1865, p. 88 (East Indies); Playfair 1866, p. 45 (Zanzibar); Klunzinger 1870, p. 759 (Red Sea); Day 1875, p. 142, pl. 34, fig. 6 (Madras); Castelnau 1879, p. 350 (Pt. Jackson); Günther 1879, p. 471 (Rodriguez); Macleay 1881, p. 118 (Pt. Jackson); Tenison–Woods 1882, p. 43 (N.S.W.); Ogilby 1886, p. 19 (Pt. Jackson); Boulenger 1887, p. 659 (Muscat); Kent 1889, p. 3, 9 (Brisbane); Day 1889, p. 47 (Madras); Sauvage 1891, p. 195, pl. 25a, fig. 3 (Madagascar); Kent 1893, p. 285 (Brisbane); Waite 1904, p. 34; Stead 1906, p. 125, 262; Pellegrin 1907, p. 203 (Tulear Bay); Stead 1908, p. 78, pl. 47 (N.S.W.); Regan 1908, p. 245 (Durban Bay); Stead 1911, p. 6; Zugmayer 1913, p. 11 (Mekran, Oman); Pellegrin 1914, p. 226 (Pt. Dauphin); Gilchrist and Thompson 1917, p. 362 (Durban Bay); Borodin 1932, p. 83 (Noumea, Brisbane).

Chrysophris sarba Cuvier 1829, p. 181 ; Voigt 1832, p. 250 ; Griffith 1834, p. 163 ; Rüppell 1835, p. 110, pl. 28, fig. 1 (Red Sea) ; Jouan 1868, p. 261 (Hong Kong).

Pagrus sarba Ogilby 1893, p. 50, pl. 14 (Pt. Jackson, Brisbane, N. Australia, New Guinea).

Austrosparus sarba Smith 1938, p. 245, pls. 18, 23 (Natal, Durban, Zululand) ; 1942, p. 281 (Zululand, Kei R., Bashee R., Knysna, Mossel Bay) ; Munro 1945 A, p. 139, fig. 2 (Noosa R., Bribie Passage, N.S.W.) ; 1945 B, p. 2.

Sparus bufonites Lacépède 1802, p. 46, 141, 143, pl. 26, figs. 2, 4, 5 (Great Equinoxial Ocean, *viz.* Mauritius–Type Locality, on Commerson MS.) ; Cuvier 1816, p. 272.

Chrysophris bufonites Cuvier 1829, p. 181 ; Voigt 1832, p. 250 ; Griffith 1834, p. 163.

Sparus psittacus Lacépède 1802, p. 47, 141, 143, pl. 26, fig. 3 (Great Equinoxial Ocean, *viz.* Madagascar–Type Locality, on Commerson M.S.).

Aurata sarba, bufonites, psittacus Cloquet 1818, p. 552, 554.

Chryseis sarba, bufonites, psittacus Schinz 1822, p. 439.

Chrysophrys chrysargyra Cuvier and Valenciennes 1830, p. 78 (Vizagapatam–Type Locality, on "Chitchillee" Russell 1803, p. 73, pl. 91).

Chrysophris chrysargyra Cuvier 1829, p. 181 ; Voigt 1832, p. 250 ; Griffith 1834, p. 163.

Chrysophrys aries Temminck and Schlegel 1834, p. 67, pl. 3, fig. 31 (Nagasaki–Type Locality) ; Richardson 1846, p. 240 (Japanese and Chinese Seas) ; Bleeker 1854–7, p. 87 (Nagasaki) ; Günther 1859, p. 489 ; Martens 1876, p. 388 (Yeddo, Yokohama) ; Steindachner and Döderlein 1884, p. 18 (Tokyo, Tango) ; Nyström 1887, p. 13 (Nagasaki) ; Day 1888, p. 788 ; 1889, p. 46 (Sind) ; Casto de Elera 1895, p. 483 (Luzon, Cavite, Santa Cruz) ; Rutter 1897, p. 76 (Swatow) ; Ishikawa and Matsuura 1897, p. 53.

Sparus aries Bleeker 1873, p. 138 (China) ; 1879 B, p. 18 (Nagasaki) ; Jordan and Snyder 1901 A, p. 355 (Tokyo) ; 1901 B, p. 79 (Yokohama, Nagasaki, Tano) ; Kishinouye 1907, p. 329 ; Jordan and Thompson 1912, p. 58, fig. 9 (Wakanoura, Nagasaki, Tokyo, Hong Kong, Moreton Bay) ; Snyder 1912, p. 415 (Tokyo, Shimizu, Kagoshima) ; Jordan, Tanaka and Snyder 1913, p. 172 ; Izuka and Matsuura 1920, p. 149 (Tsu, Tse) ; Oshima 1927, p. 148 (Pescadores Is., Keelung) ; Schmidt 1931, p. 69 (Nagasaki) ; Tanaka 1932, p. 189, fig. ; 1933, p. 1100, fig ; Okada 1938, p. 194.

Sargus auriventris Peters 1855, p. 243 (Mozambique–Type Locality, Madagascar) ; Günther) 1859, p. 445 ; Peters 1876, p. 438 (Mauritius) ; Steindachner 1876, p. 204 ; Bleeker 1879 A, p. 12. (*Non* Smith 1938, p. 247).

Diplodus auriventris Barnard 1927 p. 689.

Diplodus (*Rhabdosargus*) *auriventris* Fowler 1933, p. 178.

Chrysophrys natalensis Castelnau 1861, p. 25 (Natal–Type Locality) ; Gilchrist and Thompson 1908, p. 171 ; 1917, p. 361. (*Non* Fowler 1925, p. 237, fig. 4).

Sargus holubi Steindachner 1881, p. 208, pl. 3 (Algoa Bay–Type Locality) ; Regan 1908, p. 244 (Kosi Bay, Algoa Bay) ; ? Lampe 1914, p. 237, fig. 5 (Simonstown) ; ? Von Bonde 1924, p. 21.

Roughleyia tarwhine Whitley 1931, p. 319 (Holotype, I 15267 from Macleay R.–Type Locality) ; Serventy 1938, p. 300 (Fremantle, Swan R.).

Sparus latus (*Non* Houttuyn) Jordan and Evermann 1902, p. 350 (Giran) ; Jordan and Richardson 1909, p. 189.

Chrysophrys hasta (*Non* Bloch and Schneider) Tenison–Woods 1882, p. 43 ; Cohen 1892, p. 15.

Chrysophrys datnia (*Non* Hamilton–Buchanan) Ogilby 1898, p. 129.

Diplodus nigrofasciatus (*Non* Regan) Fowler 1925 p. 234 (Delagoa Bay).

Chrysophrys haffara (*Non* Forskål) Day 1875, p. 142, pl. 35, fig. 1 (Sind) ; Sauvage 1891, p. 194, pl. 25a, fig. 1 (Madagascar) ; Pellegrin 1905, p. 84 (Baie d'Along) ; 1914, p. 266 (Ft. Dauphin).

Smith (1942) considered *Sargus auriventris* Peters (1855) as a synonym of *Sparus sarba* Forskål (1775). The latter is known from the type locality of the former, namely Mozambique (also Madagascar), and Peters' diagnostic character " Am Bauche zicht sich jederseits über den Bauchflossen eine schmale goldene Binde entlang " applies equally well to both species. The oblique yellow band of the belly might imply only one other African species, *Prionosparus tricuspidens* Smith (1942), which has a medio-lateral golden streak and is unknown as far north as Mozambique. Barnard (1927) added *Sargus holubi* Steindachner (1881) to the synonymy of *sarba*. The original account of *Diplodus nigrofasciatus* Regan (1908) does not agree with *sarba*, but Fowler's (1925) *nigrofasciatus* is identical with *sarba*. *Chrysophrys natalensis* Castelnau (1861) from Natal is a synonym ; but Fowler's specimen (1925) with " a gold stripe through the centre of the body " is probably *tricuspidens*. *Chrysophrys aries* Temminck and Schlegel (1843) from Japan differs from *sarba* only in colour of ventral and anal fins, which are dusky instead of yellow. Kishinouye (1907) lists both from Japan. Those who have compared Japanese specimens with material from other parts of the range agree that *aries* is a synonym of *sarba*. Jordan and Thompson (1912) claimed that specimens from Hong Kong, Japan and Queensland belong to the same species. Jordan and Starks (1917) showed that specimens from Ceylon agree with those from China and Queensland. Fowler (1933) found Australian examples identical with those from Japan and South Africa. The single specimen from Mauritius (Australian Museum B 3993), appears similar in all characters to Australian specimens. *Roughleyia tarwhine* Whitley (1931), (Type Locality—Macleay River) is a synonym of *sarba*. Whitley failed to indicate any differences. Although certain references to *haffara* (see above) refer to *sarba*, it is doubtful whether *Sparus haffara* Forskål (1775) from the Red Sea is identical or even related. Descriptions refer to small specimens, and the sharp angularity of the snout, as figured by Rüppell (1835), suggests possible identity with the young of *sarba*. Dr. Blegvad, with whom I have communicated, could not find a specimen of *haffara* in Forskål's " Herbarium " but he examined a specimen in the Zoological Museum of Copenhagen determined by Professor Lütken. This latter does not correspond to *sarba* in fin counts, scale counts, body proportions or dentition and is undoubtedly a different species, probably not even referable to *Rhabdosargus*.

MATERIAL.—*Queensland Museum*—I 390, 2591 (Tweed R.), I 970, 2591, 4938 (Moreton Bay), I 5057 (Redcliffe), I 6202 (Ayr), I 6232 (Townsville). *Australian Museum*—I 1345 (2, Pt. Jackson), I 13897–8 (Sydney Markets), I 15267 (Macleay R.), I 849 3338 (L. Macquarie), I 18274 (Burdekin R.), IA 7213, I 12233–4 (Fremantle), IA 7191, I 4213 (Swan R.), I 13158–9 (Sharks Bay), I 7030 (Mandurah), I 15047 (unlocalised). *Other material*—Townsville, Noosa R., Bribie Passage, Moreton Bay, Tweed R., Bellinger R., Nambucca R., Camden Haven, L. Macquarie, Tuggerah L., Hawkesbury R., Pt. Hacking, Shoalhaven R., Mandurah.

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TABLE I.—FIN COUNTS OF AUSTRALIAN BREAM.

Species.	Number of Observations.	Dorsal Spines.				Dorsal Rays.						Anal Spines.	Anal Rays.					Ventral Spines.	Ventral Rays.	Pectoral Rays.				
		10	11	12	13	10	11	12	13	14	15	3	8	9	10	11	12	1	5	13	14	15	16	17
australis	175	2	159	11	..	1	41	130	3	..	..	175	23	141	7	..	..	110	110	..	3	124	1	..
butcheri	187	1	169	16	1	1	32	148	6	..	..	186	16	168	3	..	..	83	83	..	10	171	6	..
berda	35	..	34	1	..	1	4	28	1	..	..	35	3	32	..	..	..	35	35	..	..	34	0	1
latus	7	..	7	..	..	..	2	5	..	..	..	7	2	5	..	..	..	4	4	1	0	4	..	..
palmaris	4	..	4	..	..	..	1	3	..	..	..	4	..	4	..	..	..	4	4	..	..	4	..	..
sarba	89	..	89	..	..	..	..	..	34	51	3	89	..	..	1	39	49	89	86	1	9	74	..	..

TABLE II.—SCALE COUNTS OF AUSTRALIAN BREAM.

Species.	Number of Observations.	Pre-operculum.			Operculum.			Above L. lat.					Below L. lat.						
		4	5	6	4	5	6	4	5	6	7	8	11	12	13	14	15	16	17
australis	128	..	27	24	14	37	..	18	92	3	..	..	1	59	34	7	2	..	..
butcheri	187	14	19	22	27	34	3	..	174	4	..	..	..	..	14	22	87	58	3
berda	35	..	26	9	30	4	..	28	..	..	..	..	14	21	..	..	..	..	..
latus	6	..	..	5	4	1	..	4	2	..	..	..	1	1	3	1	..	..	..
palmaris	4	..	3	1	2	2	..	4	..	..	..	..	1	2	1	..	..	..	..
sarba	77	20	37	4	62	1	..	..	..	..	74	2	..	1	5	53	15	3	..

Species.	Number of Observations.	Lateral Line.																								
		46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
australis ..	128	..	1	8	4	25	17	25	19	13	12	2	1	1	..	..	..	..	..	..	..	..	..	..	..	..
butcheri ..	187	..	..	..	..	3	2	10	28	35	42	36	16	6	2	3	2	2	..	..	..	..	..	..	..	..
berda ..	35	2	0	4	6	12	3	6	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
latus ..	6	..	..	1	0	2	2	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
palmaris ..	4	..	..	..	..	1	0	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
sarba ..	77	..	..	..	..	..	..	..	..	..	1	0	0	0	0	7	4	13	14	12	18	6	0	0	0	2

TABLE III.—GILL-RAKER COUNTS OF AUSTRALIAN BREAM (1ST GILL-ARCH).

Species.	Number of Observations.	Dorsal limb.					Ventral limb.								Total rakers.						
		5	6	7	8	9	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
australis ..	121	2	21	57	34	7	..	..	3	32	47	31	0	1	1	4	24	48	30	10	1
butcheri ..	168	2	41	103	22	..	..	..	1	8	95	61	2	..	1	6	27	68	54	11	..
berda	30	1	14	8	7	..	..	..	..	..	4	19	7	..	..	..	3	9	11	2	..
latus	6	3	2	1	..	..	..	..	..	2	3	1	..	..	1	3	1	0	1	..	..
palmaris ..	4	..	3	1	..	..	..	..	..	1	3	..	..	..	..	1	2	1	..	..	..
sarba	84	7	60	10	..	..	..	3	2	45	31	3	..	..	11	35	28	7	..	..	..

TABLE IV.—BODY PROPORTIONS OF AUSTRALIAN BREAM.

L.C.F. = Length to Caudal fork ; tail length = distance from hypural to tail tips.

Ratio.	Species.	Number of Specimens.	Range in Body Length (mm.).	Observed Range.		Arithmetic Mean.
				Minimum.	Maximum.	
L.C.F./Head length	*australis*	428	34–453	3·23	5·73	3·86
	butcheri	186	70–413	3·11	4·50	3·75
	berda	35	79–340	3·33	4·16	4·51
	latus	5	165–302	3·33	3·68	3·53
	palmaris	4	210–278	3·33	3·66	3·46
	sarba	85	59–402	3·50	5·95	4·00
L.C.F./Tail length	*australis*	247	34–181	3·34	5·57	4·14
	butcheri	173	77–402	3·25	7·70	5·41
	berda	24	79–281	4·29	5·63	4·89
	latus	5	165–302	3·36	3·68	3·53
	palmaris	2	210–218	4·28	4·45	4·36
	sarba	68	59–308	3·47	5·05	3·93
L.C.F./length to ventral fin origin	*australis*	236	71–213	2·63	4·13	3·09
	butcheri	145	119–413	2·59	3·95	3·11
	berda	23	79–281	2·79	3·19	3·00
	latus	1	180	4·28	4·28	4·28
	sarba	24	83–308	3·07	3·56	3·28
L.C.F./length to anus	*australis*	402	34–312	1·53	2·56	1·68
	butcheri	145	119–413	1·62	1·85	1·75
	berda	23	79–281	1·60	1·85	1·73
	latus	1	180	3·10	3·10	3·10
	sarba	24	83–308	1·78	2·11	1·93
L.C.F./height	*australis*	347	54–453	1·61	3·89	2·65
	butcheri	185	77–413	2·47	3·12	2·73
	berda	32	79–340	2·26	2·62	2·42
	latus	5	165–302	2·40	2·67	2·55
	palmaris	4	210–278	2·70	2·87	2·76
	sarba	84	59–402	2·26	3·85	2·54
L.C.F./width	*australis*	283	34–453	5·60	12·04	7·89
	butcheri	146	77–413	5·29	9·90	6·55
	berda	35	79–340	5·78	7·41	6·54
	latus	5	165–302	5·32	7·02	6·40
	palmaris	4	210–278	5·40	6·41	5·99
	sarba	66	59–402	6·28	12·31	7·84
L.C.F./pectoral fin length	*australis*	48	54–453	2·47	4·91	3·23
	butcheri	59	77–336	2·78	3·41	3·13
	berda	35	79–340	2·65	3·17	2·86
	latus	5	165–302	2·90	3·14	3·05
	palmaris	4	210–278	2·94	3·12	3·03
	sarba	66	59–402	2·81	5·04	3·51
Head length/Snout length	*australis*	50	54–453	2·14	3·56	2·55
	butcheri	64	70–336	1·86	3·67	2·69
	berda	35	79–340	2·12	3·48	2·74
	latus	5	165–302	2·16	2·38	2·26
	palmaris	4	210–278	2·03	2·61	2·31
	sarba	62	59–402	1·78	2·67	2·19
Head length/maxilla length	*australis*	75	54–453	2·17	3·05	2·60
	butcheri	64	70–336	1·86	3·67	2·62
	berda	35	79–340	2·00	2·75	2·39
	latus	5	165–302	2·05	2·35	2·19
	palmaris	4	210–278	1·97	2·38	2·16
	sarba	66	59–402	2·05	3·14	2·42

TABLE IV.—BODY PROPORTIONS OF AUSTRALIAN BREAM—*continued.*

L.C.F. = Length to Caudal fork ; tail length = distance from hypural to tail tips.

Ratio.	Species.	Number of Specimens.	Range in Body Length (mm.).	Observed Range.		Arithmetic Mean.
				Minimum.	Maximum.	
Head length/Interorbital width ..	*australis* ..	50	54–453	2·71	3·92	3·12
	butcheri ..	63	70–336	2·64	4·00	3·28
	berda ..	35	79–340	2·60	3·81	3·12
	latus ..	5	165–302	3·04	3·26	3·13
	palmaris ..	4	210–278	2·95	3·24	3·06
	sarba ..	66	59–402	2·28	3·63	2·92
Head length/Eye diameter.. ..	*australis* ..	77	54–453	3·00	6·53	3·86
	butcheri ..	64	70–336	2·63	5·82	4·04
	berda ..	35	79–340	2·56	4·70	3·70
	latus ..	5	165–302	3·92	5·47	4·56
	palmaris ..	4	210–278	4·13	4·77	4·39
	sarba ..	66	59–402	2·14	5·00	3·27
Head length/Suborbital depth ..	*australis* ..	48	54–453	4·20	8·50	5·96
	butcheri ..	49	70–336	3·86	10·00	6·91
	berda ..	35	79–340	5·50	9·00	6·82
	latus ..	5	165–302	4·55	6·20	5·12
	palmaris ..	4	210–278	4·77	6·75	5·77
	sarba ..	60	59–402	2·95	5·67	4·17
Head length/4th Dorsal Spine length	*australis* ..	48	54–453	1·82	2·97	2·19
	butcheri ..	58	77–336	1·83	2·77	2·20
	berda ..	35	79–340	1·77	2·37	2·07
	latus ..	5	165–302	1·95	2·73	2·33
	palmaris ..	4	210–278	2·45	2·63	2·52
	sarba ..	65	59–402	1·67	2·79	2·22
Head length/Dorsal Ray length ..	*australis* ..	48	54–453	2·00	3·40	2·54
	butcheri ..	57	77–336	2·10	3·41	2·63
	berda ..	34	79–281	1·88	3·29	2·48
	latus ..	5	165–302	2·33	2·93	2·60
	palmaris ..	3	210–278	2·62	2·95	2·81
	sarba ..	62	59–402	1·93	3·83	2·46
Head length/2nd Anal Spine length	*australis* ..	47	54–362	1·58	2·67	1·95
	butcheri ..	59	77–336	1·61	3·12	2·10
	berda ..	35	79–340	1·39	2·13	1·71
	latus ..	5	165–302	1·63	2·93	2·27
	palmaris ..	4	210–278	2·13	2·25	2·44
	sarba ..	64	59–402	1·67	3·89	2·44
Head length/Anal Ray length ..	*australis* ..	48	54–453	1·88	3·40	2·50
	butcheri ..	57	77–336	2·10	3·34	2·67
	berda ..	35	79–340	1·94	3·08	2·49
	latus ..	5	165–302	2·23	2·83	2·57
	palmaris ..	4	210–278	2·53	2·86	2·69
	sarba ..	63	59–402	2·00	4·26	2·50
Head length/Ventral Spine length	*australis* ..	49	54–453	1·70	3·14	2·11
	butcheri ..	58	77–336	1·71	2·78	2·18
	berda ..	35	79–340	1·67	2·46	1·95
	latus ..	5	165–302	1·81	2·43	2·24
	palmaris ..	4	210–278	2·11	2·33	2·24
	sarba ..	65	59–402	1·69	3·21	2·08
Head length/Ventral Ray length ..	*australis* ..	47	54–453	1·25	1·85	1·47
	butcheri ..	59	77–336	1·23	1·86	1·50
	berda ..	35	79–340	1·18	1·60	1·38
	latus ..	5	165–302	1·42	2·23	1·65
	palmaris ..	4	210–278	1·53	1·56	1·55
	sarba ..	61	59–402	1·16	1·92	1·43

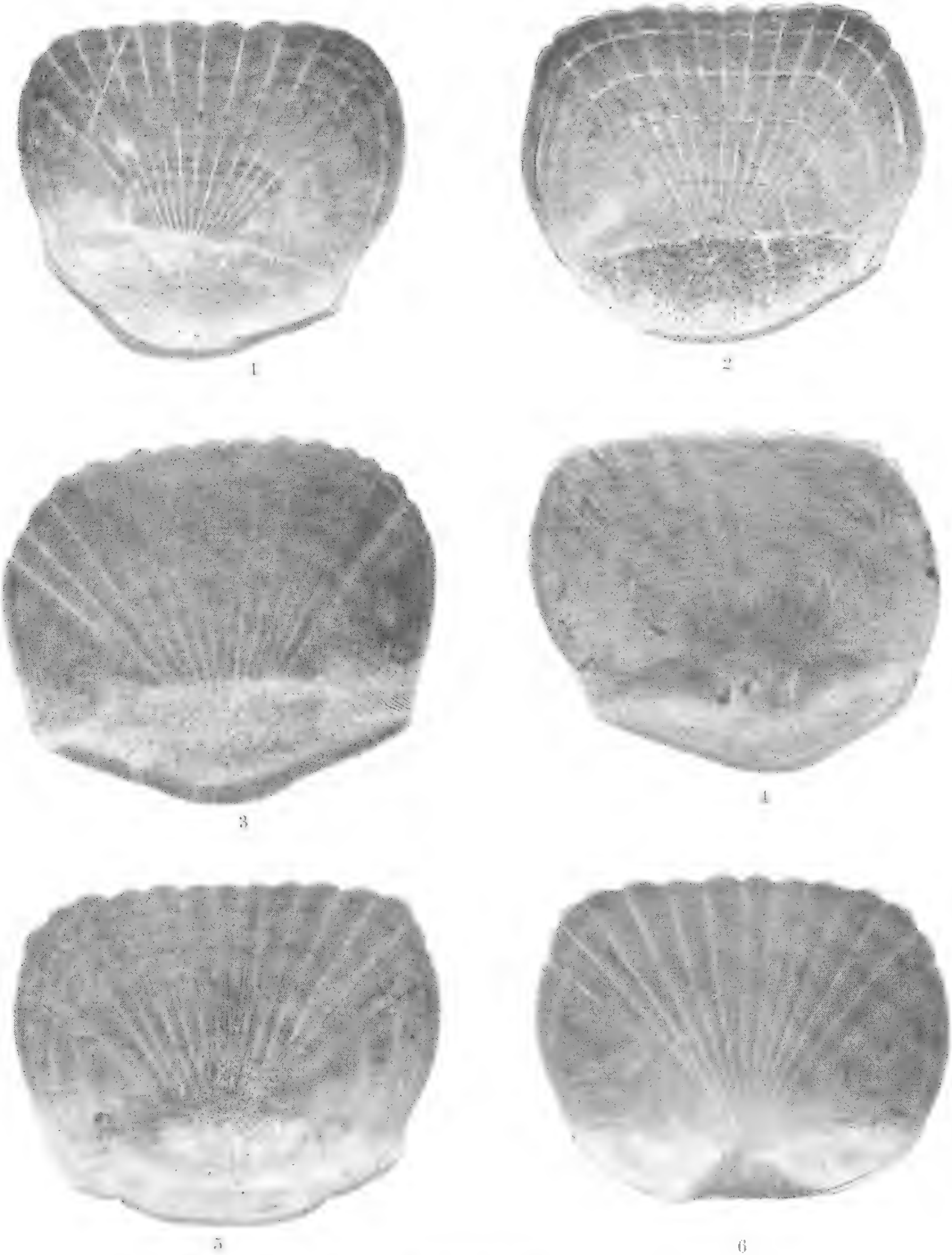
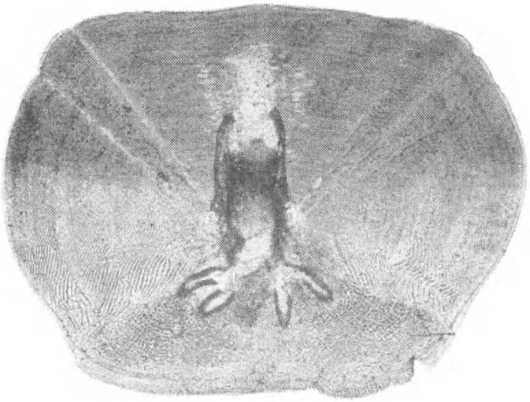


PLATE XXII.—Scales of Australian Bream (below Lateral Line).

1. *Mylio australis* (Günther).
2. *Mylio butcheri* sp. nov.
3. *Mylio berda* (Forskål).
4. *Mylio latus* (Houttuyn).
5. *Mylio palmaris* (Whitley).
6. *Rhabdosargus sarba* (Forskål).



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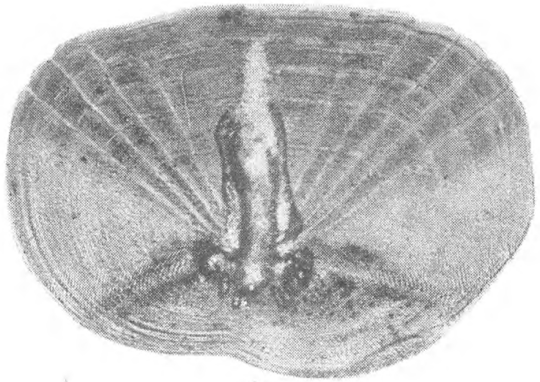

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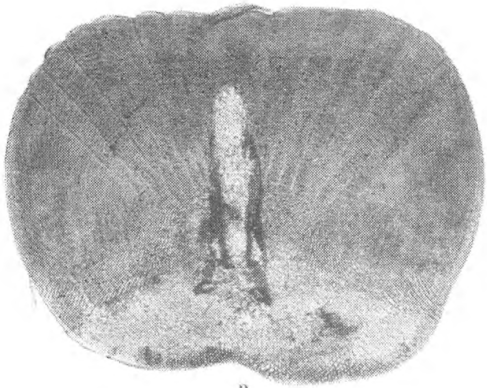

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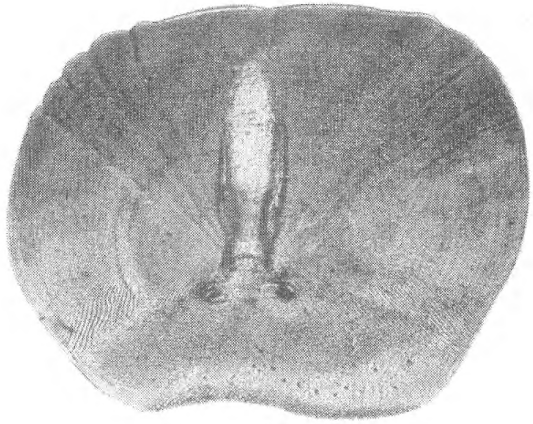

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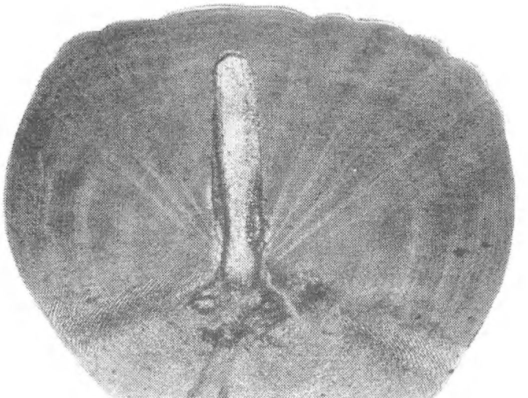

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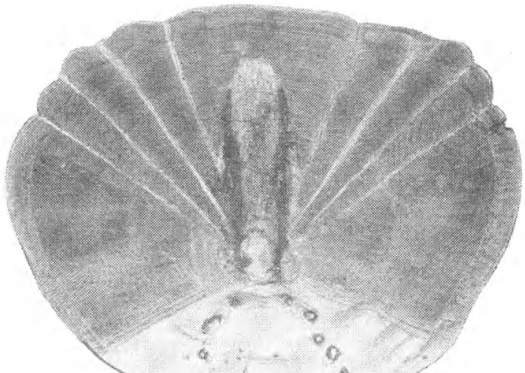

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PLATE XXIII.—Scales of Australian Bream (Lateral Line).

1. *Mylio australis* (Günther).
2. *Mylio butcheri* sp. nov.
3. *Mylio berda* (Forskål).
4. *Mylio latus* (Houttuyn).
5. *Mylio palmaris* (Whitley).
6. *Rhabdosargus sarba* (Forskål).

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